STERN-WHEEL LIGHT-DRAUGHT STEAMER.

WE give an illustration of a class of shallow draught steamer, of which several have been constructed by Messrs. Yarrow and Co., of Poplar, Eng. The stern-wheel type of steamer, as our readers know, is much used in the United States; but the vessels built there being constructed of wood are much heavier than the one we illustrate, which is, throughout, of Bessemer steel.

We annex below a few of the leading particulars of this vessel:

	Feet.	Inches.
Length over all	120	0
Length at water-line	100	0
Beam	24	0
Draught with twelve hours' fuel on board.	0	13
Speed at the above draught 13 miles an hour.		
Draught with 70 tons of cargo on board..	2	1
Speed with the above draught 10½ miles an hour.		
Diameter of cylinders	0	13
Stroke	3	0
Working pressure, 120 lbs.		
Diameter of wheel	12	0
Breadth of wheel	16	3

Bulkheads. There are numerous bulkheads, forming fourteen water-tight compartments, so that in case of damage to any portion of the hull the injury is localized sufficiently to avoid risking the safety of the vessel.

wheelers, that by tightening up the diagonal tie-bars, and thereby throwing an initial strain upon the structure, any excessive vibration is avoided, and it is this vibration which in lightly-built side-wheel boats practically limits their speed by determining the strength and weight of the construction.

Messrs. Yarrow & Co. have built vessels such as we illustrate for the East Indies, Canada, and South America.—*Engineering.*

THE PROGRESS OF STEAM SHIPPING.

AT the meeting of the session of the Institution of Civil Engineers, lately held in London, Mr. George Robert Stephenson, President, in the chair, the paper read was a "Review of the Progress of Steam Shipping During the Last Quarter of a Century," by Mr. Alfred Holt, Memb. Inst. C. E., of Liverpool. In the interval referred to it might be broadly stated that British carriage by sea had been transferred from sailing vessels to steamers. The production of steamers had been greatly fostered at the commencement of the period by the remunerative nature of the transport services during the Crimean War. Three changes of construction had rendered this extension possible. They were—the screw propeller, the iron vessel, and the compound engine. The peculiar merits of the screw propeller were, that it was equally effective at varying draughts, that it was indifferent to rolling, and that it was capable of being used either for low or high powers. By the construction of iron vessels much greater carrying capacity, in proportion to the power required for propulsion, was possible than could have been attained with wood. The process of lengthening the vessel,

that of the best compound engines, although the pressures were much less. The Americans had consistently held to the single cylinder, and there was a laudable and frequently most successful daring in their designs. It was even a matter of reasonable speculation whether the compound engine might not yet be abandoned, and a return be made to the single-cylinder engine, modified in details to suit high-pressure steam. The various types of screw engines in use since 1852 were then described, accompanied by a statement of the consumption of coal in the different types, showing progressive economy, resulting in a consumption of just under 4 lb. of coal per indicated horse power per hour. This was, however, too great for long voyages to be remunerative, if exclusively supported by freight and passage money. Hence, attention was directed to the use of high-pressure steam in two cylinders, the great pressure in a small cylinder and the small pressure in a large one. For many years Messrs. Randolph & Elder had constructed engines on that principle, and to that firm was attributed the introduction of the compound engine for marine purposes. The arrangement which had found most favor was the inverted type, with the cylinders alongside each other, and the cranks coupled generally at right angles. Another arrangement, now coming into vogue for large engines, was that with four cylinders in two pairs, each pair concentric, usually with the high-pressure cylinder on the top, and having one common piston rod. There were many other arrangements, some with combined horizontal and vertical cylinders, others with three cylinders, and a considerable number with two cylinders adjusted as a single engine, one crank and a fly-wheel. As fresh water, or an approach to it, was absolutely necessary for high-pressure
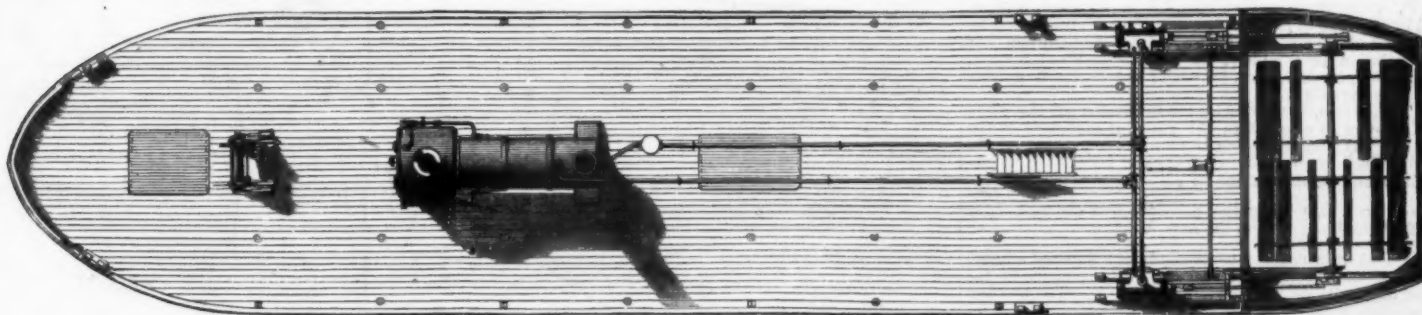
SHALLOW DRAUGHT STERN-WHEEL STEAMER FOR THE HUDSON BAY COMPANY.

Messrs. Yarrow & Co. have built side-wheel steamers of precisely the same dimensions, displacement, and power as the above, and they find from actual practice there is no perceptible difference in speed between the two systems, and we believe the experience of American builders leads to the same result. It must be clearly understood, however, this observation only refers to vessels of extremely shallow draught.

For obtaining strength and lightness the stern-wheel system offers the builder great facilities, for the following reasons:

It will be seen the boiler and the engines, by being placed at the two extreme ends of the vessel, throw a tensional strain upon the upper part of the hull, which strain is taken advantageously and with a small weight of material by the system of trussing, as shown; if, however, the same weight of machinery were placed in the middle of the vessel, as in a side-wheeler, a compressive strain would be thrown upon the deck, a strain which it is difficult to resist except by adding considerable additional material and consequent weight. It is found, moreover, from actual practice with stern-

for the purpose of arriving at the greatest displacement with the least resistance, had gone through several interesting phases. Probably the most economical vessels were now somewhat of the following proportions: Length 7¾ times the beam, and depth ⅝ to ¼ thereof. These vessels had engines of one nominal horse power to 10 tons of gross register tonnage, and realized an average speed of 8½ knots per hour. The compound engine was merely an application of long enunciated ideas to appropriate purposes. The three properties of steam—direct pressure, expansion, and condensation—could, no doubt, be utilized for the production of power more economically in one cylinder than in two or more; but the circumstances suiting such application rarely presented themselves afloat. A long stroke, a deliberate movement of parts, and an arrangement of valves admitting great range of expansion, and therefore complicated in details, were necessary. The first and second were not practicable, and the third was inadmissible, in a screw steamer; but where these could be obtained, as in the walking beam engine of the American paddle-wheel boat, the duty performed for the fuel consumed approached very nearly to

boilers, surface-condensers were employed, and the cooling surface was generally provided in small thin brass tubes. The boilers varied in design, but the general type was similar (with the modifications necessitated by the higher pressure) to the old low pressure boiler. The consumption of the best specimens of such engines as had been described varied from 2 lb. to 2¼ lb. of good coals per indicated horse power per hour. Increased economy must, in future, be sought in higher pressures, changed proportions and improvements of detail. Twenty-five years ago twice as much fuel was required as was now burnt; if in the next twenty-five years 20 per cent. further reduction took place, it was as much as could be hoped for. Viewed from the side of the owners' pocket, coals were no longer the chief item of expenditure; there were other and heavier disbursements in which to effect a saving—wages, dues, insurance, repairs, etc.

The indicator diagram was not implicitly to be relied on as a test of useful effect, though, as an instrument to detect faults, the value of the indicator was considerable. Simplicity in form, accessibility of parts, freedom from likeli-
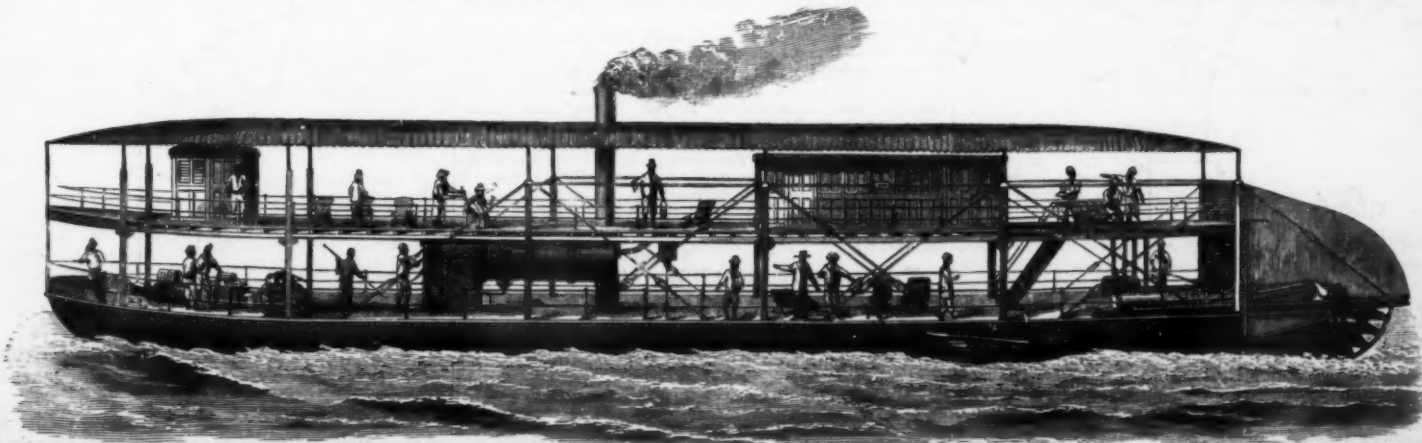
SHALLOW DRAUGHT STERN-WHEEL STEAMER FOR THE HUDSON BAY COMPANY.

hood of derangement, and ease of repair, were becoming daily more marked features in the steamboat engine, even if these entailed slight departures from the most economical form. Forty days' continuous steaming, without a stop, was not uncommon performance, and the longest distances in the world were now accomplished by steamers. The reason of the unforeseen failure of the auxiliary steam vessel was probably twofold. In such vessels the sailing department could not be economized, while it was practically impossible to keep the engine expenses in a reasonable proportion to engine services.

No review of recent steamboat enterprise and progress would be complete which did not touch on the part Government had played in various ways, whether (1) by subsidies for the maintenance or assistance of mail services, or (2) by interference in design, condition, and equipment, on the plea of providing for public safety. Both were difficult problems, but unmixed good had certainly not been the result of this action. Postal subsidies brought lines earlier into existence, but postponed improvements. They were monopolies, the Government money being used to crush competition. In the author's opinion, the day of subsidies was nearly over. The Board of Trade inspection had grown up from a simple survey to a minute and comprehensive inspection. This was attributable to the popular outcry for safety, and the resulting emotional legislation was the cause. The executive department of the Board of Trade professed dislike to much of this interference; nevertheless, its officers were instructed to survey so much in detail, and according to lengthy directions, as actually to amount to designing. The system was too new to have wrought much ill as yet; but resistance to novelties and preference for stereotyped forms might naturally be expected. The eccentricity of the laws was noticeable, of which one illustration might be given. The public rode with perfect safety behind a railway engine, the boiler of which contained steam of 120 lbs. pressure; whereas in a steamboat the pressure was restricted by law to about 70 lbs.

Although no doubt a few persons had reaped considerable rewards, yet as a whole, and viewed over a series of years, ship owning had been a bad trade for most of those engaged in it. It was a matter of frequent remark that profit and comfort were driven out of any trade a steamboat entered. In fact, the one who had almost alone benefited by the change had been the consumer.

GRAPHICAL DETERMINATION OF THE VOLUME AND SURFACE OF BODIES, GENERATED BY REVOLUTION.

By WALTER G. BERG.

Guldin's rule.—1. The body generated by any plane surface F, evolving around an axis XX in its plane, is measured by the area of the generating surface F multiplied by the length of the arc, described by its center of gravity. If the revolution be complete, the volume is: $V = 2 p \pi \times F$, p being the perpendicular distance of the center of gravity of F from the axis XX.

2. The surface, generated by the revolution of any plane line L around an axis XX in this plane, is measured by the length of the generating line L, multiplied by that of the arc, described by the center of gravity of L. If the revolution be complete, the surface is:

$S = 2 q \pi \times L$, q being the perpendicular distance of the center of gravity of L from the axis XX.

The first rule enables us to find the volume of a body, generated by revolution, if we know the position of the center of gravity of the generating figure F. The problem is therefore reduced to the determination of the center of gravity of an area, which is easily done by the "equilibrium-polygon," given in Culmann's theory of Graphical Statics. Divide the proposed area A E F G H I (Fig. 1) into triangles, trapezoids, parabola-segments, etc., determine the
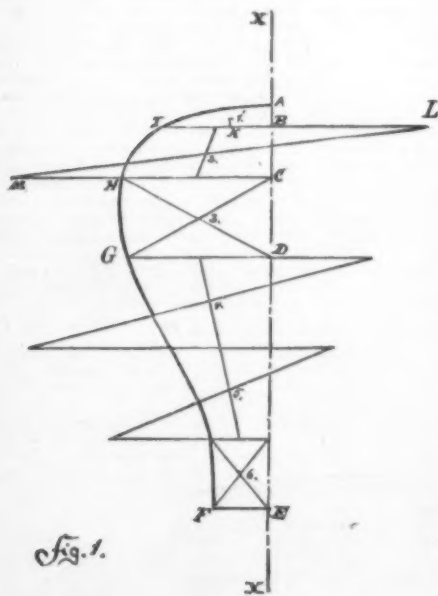

Fig. 1.

center of gravity of each part and let parallel forces act in these points proportional to the area of the same part. In Fig. 1 (the scale of length being in all the figures 4 feet to an inch), point 1, the center of gravity of the parabola-segment A B I is found by laying off $BK = \frac{1}{5} BI$, $K 1 = \frac{2}{5} A B$ and $\frac{1}{2} AB$. Then prolong IB and CH so that $BL = CH$, $HM = IB$; the intersection 2 of ML and the line joining the centers of the parallel sides IB and CH is the center of gravity of the trapezoid B U H I.

Further C D G H can be considered as a rectangle and the center of gravity 3 is the intersection of the diagonals C G and DH. Having found likewise the other centers of

gravity 4, 5 and 6, we will proceed to the determination of the forces P_1, P_2, P_3....P_6, which must act in these points and which are, according to the above, proportional to the areas they are to represent. Thus, f denoting the areas of the parts and F that of the whole:

$f_1 = \frac{2}{3} \times AB \times BI = \frac{2}{3} \times .5 \times 2.7 = .9$ square feet;

$f_2 = \frac{BI + CH}{2} \times BC = \frac{2.7 + 3.7}{2} \times 1.2 = 3.84$;

$f_3 = CH \times CD = 3.7 \times 2 = 7.4$;

$f_4 = \frac{3.7 + 2.4}{2} \times 2.3 = 7.01$;

$f_5 = \frac{2.4 \times 1.3}{2} \times 2.2 = 4.07$;

$f_6 = 1.3 \times 1.8 = 2.34$;

hence $F = 25.56$ square feet.

If we take, as scale of area, 1 square foot = $\frac{1}{16}$ inch, the areas of the single parts or the forces P acting in their centers of gravity are represented by the above numbers.
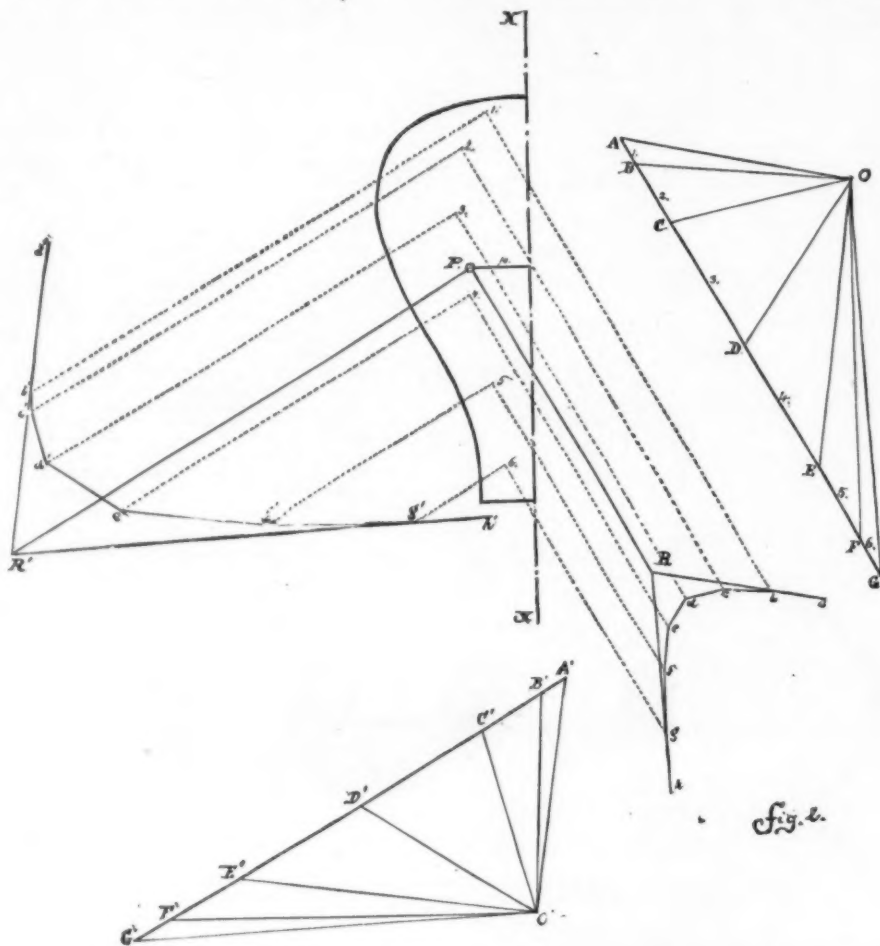
Draw in the plane a line parallel to any assumed direction of the forces P (Fig. 2) and lay off on it, considering $\frac{1}{16}$ inch as unit,

$AB = P_1 = .9$, $BC = P_2 = 3.84$, $CD = P_3 = 7.4$, $DE = P_4 = 7.01$, $EF = P_5 = 4.07$, $FG = P_6 = 2.34$;

choose any point O in the same plane and draw OA, OB, OC,....OG. This figure is called the force-polygon and O its pole. Draw anywhere a line a b ‖ OA, intersecting the line of action of P_1 in b; then draw bc ‖ OB, c being on the line of action of P_2; then cd ‖ OC ——. The rule to be followed is: The parallel to a line connecting the pole O with any point on AG must run between the lines of action of the forces next to that point in the force polygon. Thus the parallel cd to OC is limited by P_2 and P_3; the parallel d e to OD by P_3 and P_4; the parallels a b and g h to OA and OG only by P_1 and P_6. The figure a b c d.... is called the equilibrium-polygon, and by prolonging its outer sides a b and h g to their intersection R, we have in the parallel to AG through R a line on which the center of gravity P of the area F must lie.

This construction being made again for a second direction of the forces P and consequently with a new force-polygon A' G' O' and equilibrium-polygon a' b' c' ... , both constructed as above, we get in the line drawn parallel to A'G' through the intersection R' of the outer lines a' b' and g' h' of this new equilibrium-polygon a second line on which the center of gravity P must lie, as well as on that through R. Hence the intersection P of the two is the required point and $PX = p = 1.5$ ft. (measured by the scale of length) is the distance of the center of gravity of F from the axis XX, and therefore the volume of the body generated by the revolution of F around the axis is:

$V = 2 \times 1.5 \times 3.1416 \times 25.56 = 240.898$ cubic feet.

Supposing the figure to represent the profile of a balloon filled with gas of the specific gravity .5, then, if one cubic foot of air weighs .08 lbs., the carrying capacity of 1 cubic foot of gas will be $.08 - .08 \times .5 = .04$, and therefore for the above volume:

$240.898 \times .04 = 9.6$ lbs.

According to Guldin's second rule, the surface, generated by the revolution of any plane line around an axis in this plane, is known, if the length L of the line and the position of its center of gravity have been ascertained. Thus we base the solution on the determination of the center of grav-

ity of a line, which can be accomplished as above. We divide the given line into parts that are or can be considered as straight, and, if we attribute to the whole line a certain weight, we must let a force act in the center of gravity of each part proportional to its weight, i. e., proportional to its length. In Fig. 3 the curve is divided into the parts AB, BC, CD .. GH, which for convenience we will regard as straight; the center of gravity of the different parts will be in their centers 1, 2, 3....7. If we let parallel forces Q, represented by the length of the corresponding part, act in these points, we have a number of forces, from which the center of gravity Q is found, as above, with the help of force and equilibrium-polygons. The construction gives $QX = q = 2.5$ ft., and as $L = 12.7$ ft., the surface of the body will be:

$S = 2 \times 2.5 \times 3.1416 \times 12.7 = 199.49$ square feet,

which in the case of the balloon gives the amount of the material required.

In Fig. 2, two force-polygons were employed, because both the directions R and R' of the forces P were taken independently of each other. If we assume the second direction R' to be perpendicular to the first, we can dispense with

Fig. 2.

the second force-polygon A' G' O', by drawing the lines a' b', b' c', c' d'.... at right angles to the corresponding lines OA, OB, of the first force-polygon, instead of parallel to O' A', O' B', O' C' .. Accordingly the center of gravity of the contour in Fig. 4 is determined; the forces Q_1, Q_2... acting in the centers of gravity 1, 2, 3.... of the parts, into
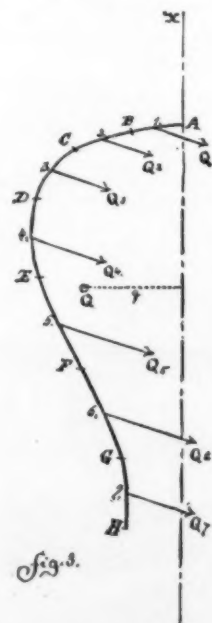
which the outline is divided, are represented by the length of these parts, as is plainly seen from the force-polygon, where AB, BC, CD... equal the length of the corresponding part. The first direction R of the forces Q must be taken parallel to AG, the second direction R' we assume to

Fig. 3.

be perpendicular to the first, and hence the second equilibrium-polygon a' b' .. g' h' can be drawn with the help of OAG, as just explained. L — AG — 12·9 ft., and QX — q — 4·5 ft.; therefore the surface S generated by the revolution of the contour around XX equals 364·74 square feet.

The center of gravity P of the area of the profile can be found as in Fig. 3; F — 37·37 square feet, PX — p — 3 ft., therefore V — 704·41 cubic feet.

Let the figure represent the profile of a copper kettle, the thickness of the copper being ⅙ inch; the volume of the metal is equal to that of a parallelopipedon with S as base and ⅙ inch as altitude, or 364·74 × $\frac{1}{72}$ — 3·8 cubic feet. If the specific gravity of copper be 8·9 and 1 cubic ft. of water weigh 62·425 lbs., then 1 cubic ft. of copper will weigh 62·425 × 8·9 — 555·582 lbs., and therefore 3·8 cubic ft. 3·8 × 555·582 — 2111·2 lbs. As one gallon — ·16 cubic ft., the vessel will hold 4402·6 gallons, and weighs 2111·2 lbs.

Fig. 5 is the profile of a bell. The parts 8 and 9 are triangles; the center of gravity of a triangle is the intersection of the lines connecting each apex with the center of the opposite side, and the area equals base multiplied by half the altitude. The second direction R' of the forces is at right angles to R, and therefore the equilibrium-polygon a' b' c' .... k' l' is obtained from the force-polygon OAK, as explained above. F — 7·48 square feet; PX — p — 4·5 ft.; therefore V — 211·493 cubic feet. Let the specific gravity of bell-metal be 8·6, then the bell will weigh 8·6 × 62·425 × 211·493 lbs. — 1013·76 cwt.

If a profile have an axis of symmetry, the required center of gravity is the intersection of this axis with the line drawn through R parallel to the direction of the forces.

To obtain accurate results the size of figures and number of parts should be larger.

PUGET SOUND LUMBER WORKS.

THE Tacoma mill is said to be one of the best shingle-mills on the sound. The actual amount of lumber turned out at this mill in a week, working 11½ hours per day, was 489,384 feet. The smallest day's cut was 77,000 feet and the largest 92,000 feet; and the average, 81,564 feet. In length the mill is something over 300 feet by 60 to 75 feet in width, and is fitted up with the latest improved machinery and appliances for the most effective and economical use of timber and labor. To drive the requisite machinery necessary to produce the enormous quantity of lumber per day above spoken of requires three engines. A gentleman who has had many years' experience in the pineries of Wisconsin, and who has been engaged in making lumber for several years on Puget sound, recently informed the writer that it required almost double the power to produce the same result here that was obtained there. His explanation of this was on account of the close texture of the fir timber as compared with the pine, rendering it almost as hard to saw as oak. This is probably one of the reasons why Puget sound fir is so desirable for shipbuilding purposes.

The largest mill on the sound is the one located at Port Gamble—this is, however, really two mills run by one company. They employ about 350 men, run nine engines with 17 boilers, and cut about 240,000 feet per day. The mill at Port Madison has made a specialty of long timber, 90 foot sticks being quite common. A number of planks have been shipped there of that length, which were 7 inches thick, and
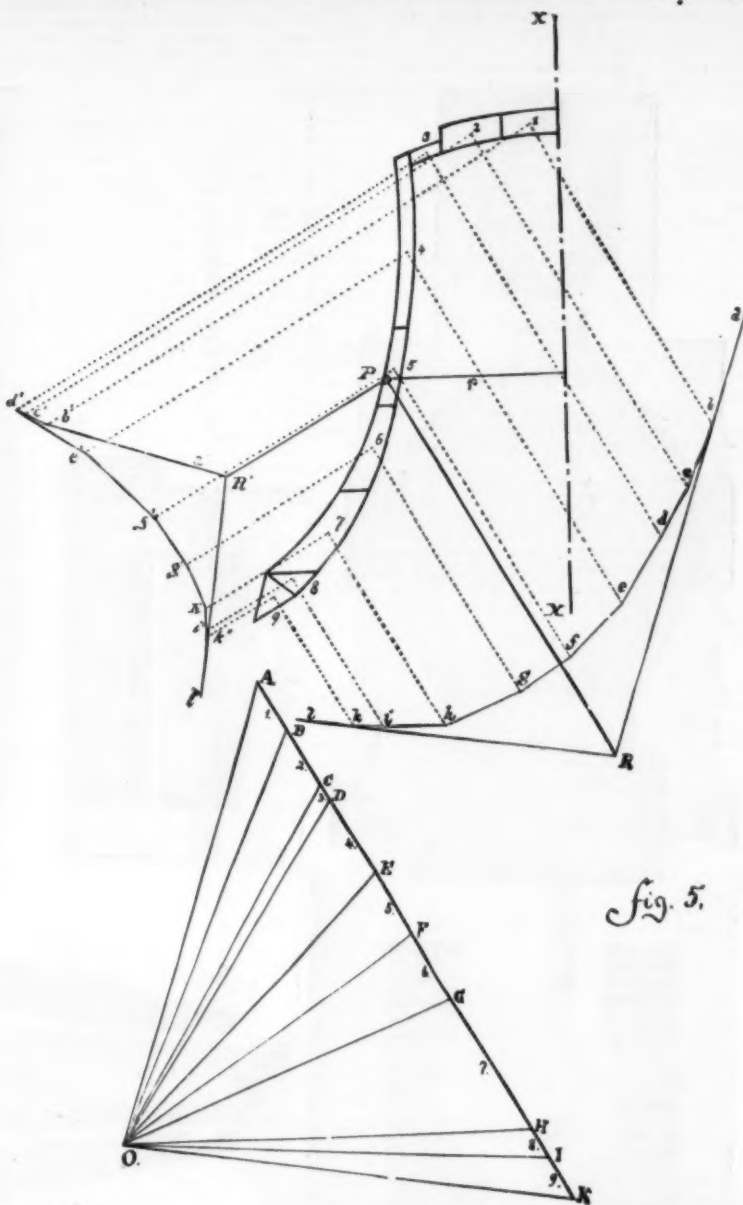

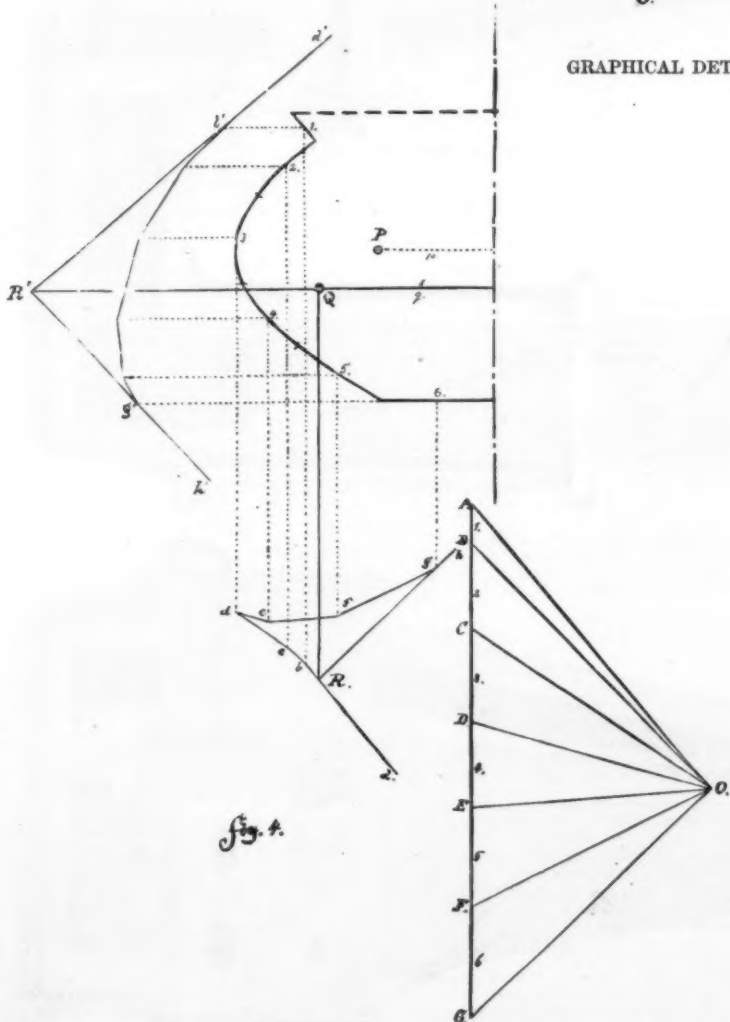GRAPHICAL DETERMINATION OF THE VOLUME AND SURFACE OF BODIES, GENERATED BY REVOLUTION.

GRAPHICAL DETERMINATION OF THE VOLUME AND SURFACE OF BODIES, GENERATED BY REVOLUTION.

of width sufficient to bring their contents up to 2,000 feet. Logs have been sawed there which weighed 25 tons, and from which were made 6,000 feet of lumber. Some years ago this mill turned out a stick 160 feet long, squaring 4 feet at one end and 18 inches at the other; also, a plank 60 feet long, 5 inches wide, and 6 inches thick. Mills are also located at New Tacoma, Seattle, Port Blakely, Freeport, Uniontown, Seaback, Port Discovery, Utsalady, and Port Ludlow. Some idea of what these mills do in one year may be obtained from the fact that they each employ from 100 to 350 men, and that during the past year they shipped 40,300,000 feet of lumber, chiefly to Peru, Chili, and the Sandwich Islands. This does not include the San Francisco market. As these shipments are made in coasting vessels, and their cargoes never entered at the custom house, it is difficult to obtain correct statistics of the amount of lumber they really carry away. A pretty fair idea may, however, be formed when I state that 60 vessels are employed in the Puget sound and San Francisco lumber trade.—*Portland, O., West Shore.*

WATCH OILS.

To the Editor of the Scientific American :

IN your SUPPLEMENT No. 105 I find a clipping from the "German Watchmaker's Journal" which imparts a great deal of general knowledge to very little particular purpose as regards the title of the essay.

Without taking up any of your valuable space to refute some slight errors in the article quoted, I propose to give your readers, especially those who are intrinsically interested in the subject, the "modus" of manufacturing their watch oil, or in fact oil which will suffer a low degree of cold and not oxidize readily.

Place into olive oil of good quality a spiral of sheet lead, expose this to the action of the oil in a temperature not below 50° F. and watch the result. You will after five to eight days observe the lead covered with small crystals of stearate and margarate of lead, leaving a diffusive oil which consists of oleate of glycerine alone. This latter constitutes your "Watch Oil."

It is necessary to have the lead reacted upon some four to six weeks before decanting the liquid and making use of it as lubricating oil.

EDWARD NEUMANN.

SELF-WINDING CLOCK.—F. Helling describes an automatic clock, in which the winding machinery is operated by the alternate expansion and contraction of glycerine, or other suitable liquid. A piston, on the surface of the glycerine, is so connected with ratchet wheels and toothed racks that motion in either direction will wind up the weight. The inventor thinks that the contrivance will be especially valuable for self-registering meteorological instruments.—*Franklin, Inst. Jour.*

SECTIONAL PLAN THROUGH A.A.

CROSS SECTION. THROUGH E.F

SECTIONAL PLAN THRO' E.E.

LONGITUDINAL SECTION THROUGH B.B.

SCALE OF FEET

PART SECTION THROUGH D.D.

PRICE'S PATENT PUDDLING FURNACE.—WOOLWICH ARSENAL, ENG.
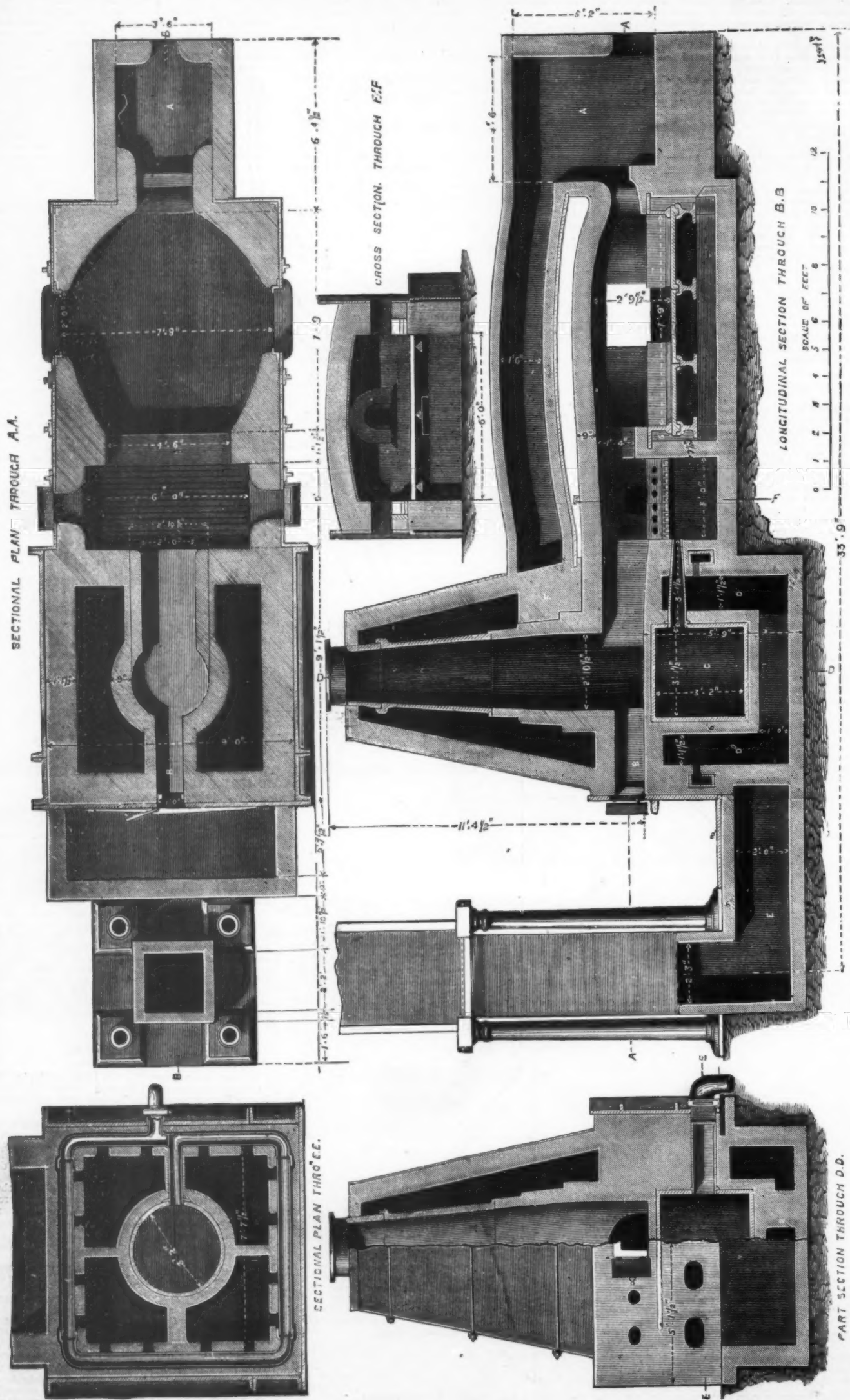
PRICE'S PATENT RETORT PUDDLING FURNACE AT WOOLWICH ARSENAL.

Of all the puddling furnaces which have come under our notice, and as to the working of which we have succeeded in obtaining trustworthy details, the retort patented by Mr. John Price is the most economical in the consumption of fuel. We believe that this assertion will be accepted without hesitation when we say that at the Royal Gun Factories, Woolwich, 902 tons of iron have been produced in twenty-four weeks, with an average consumption of 7 cwt. 1 qr. 23 lbs. of coal, and 4 cwt. 3 qr. of fettling per ton of iron. We can call to mind no result beating this in economy, the furnace working over a lengthened period. We have had occasion ere now to complain of the difficulty we have encountered in getting
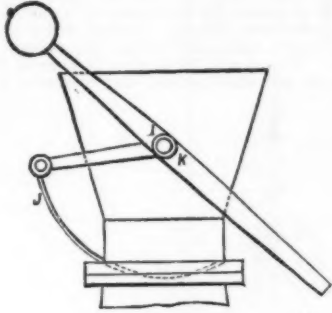
any precise figures concerning the economy of puddling furnaces. The Price furnace supplies an exception, as we have had data placed at our disposal which leaves no doubt as regards the accuracy of the figures we propose to place before our readers. In the first place, however, it will be well to describe the principle and construction of a furnace which is capable of giving such excellent results. The illustrations we give show one of several erected at Woolwich Gun Factories, under the supervision of Mr. W. Price, brother of the inventor, and mill and forge manager at the arsenal.

The furnace, it will be seen, is double, and works with a cinder bottom. At the end of the furnace is placed a dandy, A. The arrangement of the doors, plates, etc., is so far very similar to that of an ordinary furnace.

At the end furthest from the dandy is built a brick stack

burned together, filling the puddling furnace with flame. The coke on the grate is obtained from the retort. That is to say, as the coal is carbonized in the latter and sinks down, the furnaceman from time to time opens the stoking hole door B, and with a suitable iron pushes the coke in on the grate, more coal being of course added at the top of the retort. The gas as a rule is not all taken out of the coal, the small quantity that remains being given up on the grate. The conditions are the most favorable possible to perfect combustion, because one of the great difficulties met with in ordinary furnaces is entirely removed, that is to say, in ordinary furnaces the temperature of the gas as it escapes from cold fuel is too low to permit ready ignition. In this case, however, the gas enters the furnace at a temperature of 800° to 1,000°. Again, the coke on the grate is supplied not with cold but with hot air, and thus it will be seen that the conditions are not unlike those which rule in the Siemens furnace. It is not wonderful then that by making a very few alterations in the proportions of the furnace, wrought iron can be readily melted by it. Three crucibles containing each 40 lbs. of wrought iron have had their contents rendered as fluid as water in less than three hours, and steel is now being made at Woolwich in such a furnace, somewhat on the Martin system. The carbonizing of the coal, the heating of the air, and the heating of pigs in the dandy are all effected, it will be seen, by the products of combustion, which now pass off cool, instead of escaping at a temperature of 2,000° or thereabouts.

As an example of the work done by the furnace, we may mention that we saw a charge of 14 cwt. drawn from the dandy at a red heat and put into the furnace at 2.10 p.m. It consisisted of 5 cwt. of old shot, 5 cwt. of old shell, and 4 cwt. of gun iron. This was all melted, and puddled, and ready to draw at 3.35. The blooms produced worked remarkably well, and the iron was no doubt of excellent quality. The furnace is fitted with Withams' patent puddling machine, which gives very great satisfaction. It saves the under hand, at all events, a great deal of exhausting labor, and possesses the advantage that everything about it is simple, strong, flexible, and very unlikely to get out of order, or break down because of want of adjustment. The machine at Woolwich has worked continuously for forty-four weeks without accident of any kind or the loss of a single heat.

The following table gives the results obtained in regular work with the double retort furnace at Woolwich up to the 5th of May, 1877. It will be seen that the consumption of fuel has been higher than we have stated elsewhere; but against this it must not be forgotten that no trouble was taken to secure the best results, and that at Woolwich full time is not being run just now, the furnaces being kept banked up at night, which causes much waste of fuel, which would not be incurred if they ran night and day. However,

cwt. per ton of iron, which is a moderate estimate, we have a gross expenditure on fuel of £15 per week. If the consumption is reduced to one-half the saving would be £7 10s. per week, or, say, £350 a working year; so that, in little more than six months, the improved furnace would repay the £200 additional, which we may assume it would cost. Indeed, a saving of £350 a year in the cost of working a puddling furnace represents a profit so great that the first outlay sinks into insignificance beside it.

Whether the Price furnace will answer under all circumstances we do not pretend to say, but we can say that there is nothing about the way in which fuel is burned to prevent it being a success. Should it fail, the result will be due to the incompetence of those in charge of it. It requires no skill in working, but care must be taken that the retort is kept properly charged, and that the coke is thrust forward on to the grate at the proper time, or the furnace will go back; but unless proper firing is adopted with any puddling furnace a similar result must take place.—*Engineer.*

ROCK DRILLING—THE BURLEIGH DRILL.

The Burleigh rock drill has, perhaps, attained its greatest notoriety in connection with the driving of the Hoosac Tunnel, in Massachusetts. The following memoranda, given by Mr. W. Shankey, of drilling during ten shifts in a heading of the tunnel, will give some idea of the capabilities of the Burleigh. The rock was a hard gneisold rock, greatly permeated with quartz; the diameter of the holes was 1¼ in. Total time occupied in drilling, 38 hours 40 min.—2,320 min. Total number of holes drilled, 120. Total number of inches drilled, 16,948. Average depth of holes, 11 ft. 8 in. Average number of rock drills used each shift, 6. Average number of inches drilled per minute, 7·3. Average number of inches drilled per machine per minute, 1·22. In doing so the drill points were changed 694 times, which gives 24½ in. as the average number of inches drilled by each borer. The maximum shift's work, included above, is as follows: 12 holes drilled in 150 minutes, the total number of inches drilled during the time being 1,728, which gives 11½ as the average number of inches drilled per minute, and this, with six rock drills, gives 1·91 as the average advance per drill per minute. During this time the drill points were changed 51 times, which gives 28½ in. as the average number of inches drilled by each point before becoming so blunted as to necessitate changing.

In the driving of the Sutro Tunnel with the Burleigh the average daily advance in headings 9 ft. to 10 ft. by 14 ft., in which the rock was trachyte, from July to November, 1874, was 11 ft. and 12 ft. per day. The machines worked up to 300 blows per minute, with a pressure of from 60 to 70 lbs. per square each. The drill points are generally made
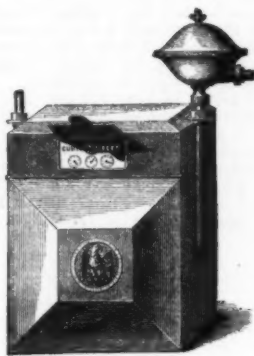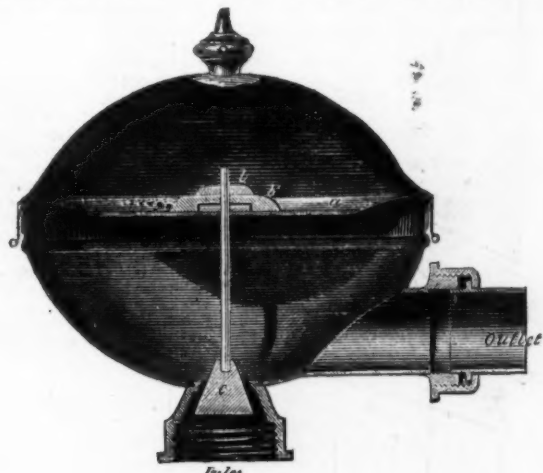

FIG. 4.

FIG. 5.

FIG. 6.

IMPROVED GAS REGULATOR.

of the dimensions shown. Inside this is constructed a retort, the lower portion of which is built of fire-brick, while the upper is a casting weighing 15 or 16 cwt. This retort is set in the brick stack as shown. Under the lower end of the retort is a dead plate, and opening on to this is the stoking hole B. The top of the retort is fitted with a hopper, removed in our engraving to save space, and shown separately in the annexed cut. The long lever K at the side is worked from the ground. A curved piece of metal J, which crosses the top of the retort, traveling in slots, closes the top, its action being very similar to that of the sliding stop of a shot pouch.

The flue from A to F returns above the main body of the furnace from the dandy, and enters the casing surrounding the retort as shown, a wedge-shaped piece of brickwork F being placed opposite its mouth, to split the current of flame and direct it right and left. The flame and smoke then pass downward into the chamber D, in which is fixed a heavy cast iron air vessel C, surrounded on all sides by the walls of D. The air for the supply of the furnace is furnished by a Lloyd's fan, blowing at a pressure of about 8 in. of water. From D the smoke and other products of combustion pass away through E to the chimney.

At one side of the retort stack is placed a pair of iron bars at an incline ; on these runs a kind of tub or bucket. When coal has to be put into the retort the blast is shut off, the damper opened, and the bucket full of coal run up to the top on the inclined railway. When it reaches the top the bucket strikes against a stop and tilts over, emptying itself into the hopper automatically.

The action of the furnace is as follows : When the fire has been lighted, and the brickwork all heated, the flame at a moderately high temperature passing through the flue from the hearth and dandy keeps the retort at a dull red heat. The coal in the retort is then almost in precisely the same condition as when in an ordinary horizontal gas retort, and is carbonized. The gas has no mode of escape save into the hearth. On the grate is, however, a thick bed of coke, kept in vivid combustion by the air heated in C to about 500°. This at once ignites the carburetted hydrogen, which, mingling with the carbonic oxide thrown off from the coke, these two are

the figures as given are perfectly reliable, and show, under the circumstances, an astonishing economy :—

	Tons.	cwt.	qr.	lbs.
Total weight of iron charged	3245	15	0	14
Total weight of iron yielded	3091	15	3	4
Total weight of scrap balls	382	4	2	0
Total weight of fettling	715	4	1	9
Total weight of coals	1633	3	2	14
Fettling average, 4 cwt. 1 qr. per ton	—	—	—	—
Coal average, 9 cwt. 1 qr. 17 lbs. per ton	—	—	—	—
Loss in yield, under 4½ per cent	—	—	—	—

It should be generally known that the larger the charges puddled the greater will be the economy of fuel. Some very careful experiments to test this point have been made by Mr. W. Price, with the following results:—

Charges.	Ordinary furnace. Coal per ton.	Retort furnace. Coal per ton.
cwt.	cwt.	cwt.
5	23	13½
10½	18	9½
15	15	7¾

The retort furnace has been tried by Messrs. Witham, of Leeds, who with 15 cwt. charges puddle a ton of iron with 7½ cwt. of coal, the iron being rather weaker and more easily puddled than that used at Woolwich.

In the Price furnace the consumption of the fuel is so complete that only about 7½ per cent. of ashes are obtained. The waste of iron is reduced to a minimum because no cutting action can take place, it being almost impossible for free air to find its way to the iron.

All things considered, the Price furnace appears to us to possess most of the qualifications required in a good furnace. It is, of course, more expensive than the ordinary furnace, the cost being about £400 for a double furnace suitable for 15 cwt. charges complete. But the first cost of a puddling furnace is really a small matter when fuel is saved. If we suppose that a furnace turns out but five tons of iron a day, the cost of coal being 10s. per ton, and its consumption 20

with four cutting edges for hard rock. In Aberdeen granite the Burleigh is said to bore, on an average, 20 in. without resharpening.

The Burleigh rock drill is said to give great satisfaction in not requiring constant repairs. As an exceptionally good instance which occurred during the driving of the Hoosac Tunnel may be cited that one machine during 2½ months drilled a length of 5,300 ft. (holes 1¼ in. in diameter) without requiring any repairs.

A NATURAL PHENOMENON.—There is said to be a well in Wise County, Texas one hundred and ten feet deep, which ordinarily has an abundant supply of water at all seasons of the year, but from which when the wind blows twelve hours from the north, no water can be drawn.

IMPROVED GAS REGULATOR.

The constant variation in the pressure of gas acts prejudicially in several ways ; in addition to the trouble of having frequently to regulate the flame at the burners, a large amount of gas passes through them unconsumed, whereby the quality or illuminating power of the light is impaired, and the atmosphere of the room made unhealthy, besides causing the meter to work irregularly. A simple governor, called the Imperial Regulator, which may be screwed on to any meter, has been especially designed to equalize the flow of gas, and so put an end to the above named difficulties. It governs the pressure of the gas so perfectly that the cocks of the burners may be turned full on when the gas is lighted, not requiring any subsequent adjustment ; and whether one light or fifty be in use, a quiet, steady light with full even flame is maintained, while a saving of from 15 to 20 per cent. is effected. Fig. 4 shows a dry meter and Fig. 5 a wet meter fitted with the governor, an enlarged section of which is given at Fig. 6. It will be observed that the orifice is conical, and that the plug or valve working in it is so arranged that the greater the pressure of gas on the diaphragm, the smaller is the annular orifice allowed for its passage.—*Iron.*

LESSONS IN MECHANICAL DRAWING.
### By Prof. C. W. MacCord.
Second Series, No. XXI.
The Screw Propeller.

But this happens, simply because we assumed the element *a e*, perpendicular to the axis, as a starting point. In Fig. 144, we assume instead the inclined right line *a b*. Now, letting *a e* represent any fraction of the pitch at the axis; draw any number of equidistant parallels to the axis, between *a* and *b*; then if the lengths of the consecutive lines 1–1, 2–2, 3–3, etc., increase as we recede from the axis, but not by a constant difference, the line, *c d*, joining their upper extremities, will be a curve, which may be taken as the second position of the generatrix. Doubling each ordinate, we determine the third position, *e f*, and so on; but neither multiples nor sub-multiples of these ordinates can have a constant difference, consequently the generatrix will be curved in every position except the original one, *a b*.

Revolving *a b* about the axis, we have a cone which occupies with respect to the surface a central position, analogous to that of the plane, *L M*, to the surface shown in Fig. 108; but the two parts into which the surface is divided are not symmetrical, nor will generatrices equidistant from the cone be similar curves.

Again, we may assume a curved generatrix to start with, as *a b* in Fig. 145. Let *c d* be the second position, say at the end of 1 complete revolution from the first. Now, if after descending for a certain number of times, be the same whole or fractional, *c d* becomes the straight line *m n*, then 1'–1, 2'–2, 3'–3, etc., must be respectively contained in 1'–*r*, 2–*x*, 3'–*a*, etc., just as many times as there are turns. In other words, the number of the turns must be a common measure

Fig. 143.

Fig. 144.

Fig. 145.
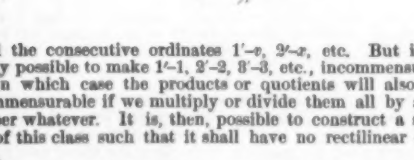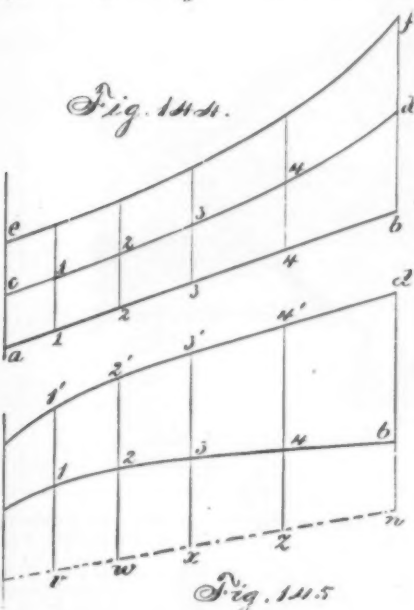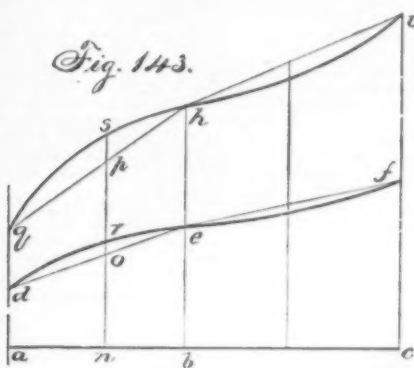
of all the consecutive ordinates 1'–*v*, 2'–*x*, etc. But it is clearly possible to make 1'–1, 2'–2, 3'–3, etc., incommensurable; in which case the products or quotients will also be incommensurable if we multiply or divide them all by any number whatever. It is, then, possible to construct a surface of this class such that it shall have no rectilinear element.

We do not consider it necessary to illustrate the process of drawing a blade of a propeller, whose acting force is of this description; we have shown in Fig. 135 how to deal with a generatrix curved in a radial plane, and with the surface struck up by it, and the only difference between that case and the supposed one lies in the change of curvature of the generatrix. And we now know how to construct the successive positions of the generatrix; but it will, no doubt, strike the reader that, since this can be done only by making use of the helical elements, it would be more simple and equally accurate to make use of the latter directly, in determining the form of the blade.

These variations, however, are of perhaps no practical use; but we see in them all this characteristic feature, that the generatrix, as we have called any section by a radial plane, during its progress changes not only its relation to the axis, but its form, except in the one original limiting case where it is always rectilinear.

It therefore appears, as above stated, that a perfectly correct surface of this kind cannot be struck up, inasmuch as the striking board cannot change its form. But it is to be observed, that the striking board, whether straight or curved, must slide upon the guide curves as well as turn in a vertical plane. Now, the generatrix moves through but a small angle in producing so much of the surface as is required for a propeller blade. And it does not seem easy to prove that under certain conditions and within those limits, it is impossible to find a curve such that the change of form shall be so

nearly compensated for by the change in position, as to render the surface practically correct. But on the other hand it seems equally difficult to prove that it is possible, and still more so to deduce any general method of finding such a curve. We therefore leave this to the ingenuity of our readers, as an unsolved problem.

The list of complications is however not yet full; for it is possible to combine radial with axial expansion of pitch. This may be done with a rectilinear generatrix, as will be seen by the aid of Fig. 146. Let the point *a* move in the direction *a d* with uniformly accelerated velocity; the distance of *b*, *c*, *d*, from *a*, being as 1, 4, 9, these points mark equal intervals of time. Also, let *e* move toward *h* with a greater velocity, but also uniformly accelerated, *a d* and *b h* being parallel; then the distances *e f*, *e g*, *e h*, being also made in the proportion of 1, 4, 9, the points *f*, *g*, *h*, will mark the same intervals of time. Then if we draw any other parallels to *a d*, as *m n*, *r p*, *s t*, it is clear that they will be divided, by right lines drawn through *b f*, *c g*, *d h*, into parts proportional to the original divisions of *a d* and *e h*. Thus, the distances of *v*, *v*, *t*, from *s*, of *x*, *y*, *p*, from *r*, and of *w*, *z*, *n*, from *m*, are in the proportion of 1, 4, 9. The reader, we think, will
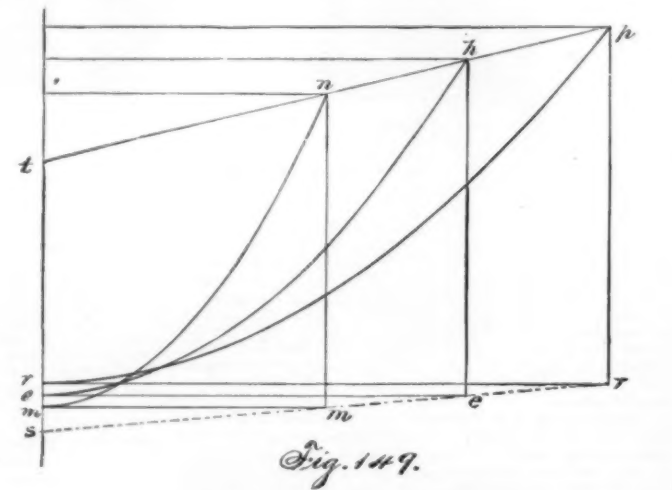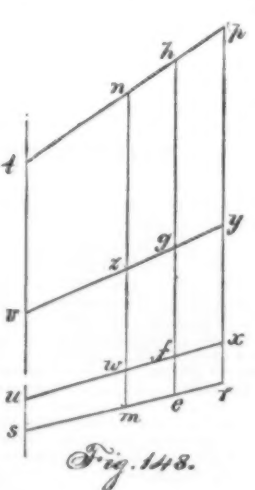

Fig. 146.

Fig. 147.
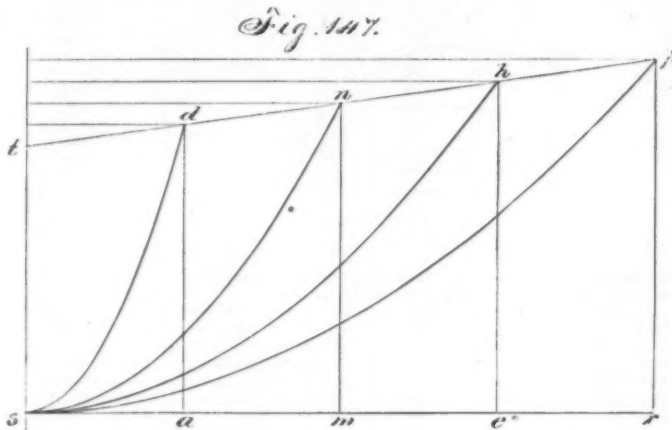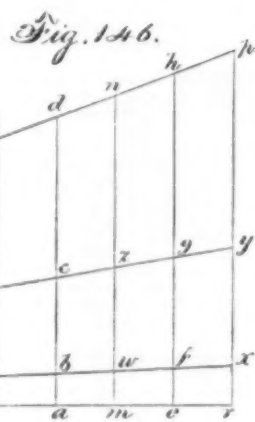
LESSONS IN MECHANICAL DRAWING.—Second Series.—No. 21.

at once see the application; if we regard *s t* as the axis of a screw-surface, we may consider for instance *a d*, *r p*, as the outlines of two concentric cylinders; then, if we suppose *s r* to revolve uniformly about *s t*, while advancing as above explained, it will trace upon those cylinders two helices of uniformly increasing but different pitches. And if we suppose *m n*, *e h*, to be the outlines of any other concentric cylinders, the lines traced upon them will be of the same nature. Upon the above suppositions, the lines *s r*, *w x*, *v y*, *t p*, will represent different positions of the generatrix resolved into the plane of the paper, as in previous illustrations; the reader will at once perceive the similarity of this diagram to the right-hand half of Fig. 141.

Now, if we develop these cylinders into planes, cutting them along the elements which pass through the points *a*, *m*, etc., of the initial position of the generatrix, we shall have Fig. 147, in which, since the distances *s a*, *s m*, etc., are the circumferences, and proportional to the radii, while the altitudes *a d*, *m n*, etc., are unchanged, the right line *p d* will still pass through *h* and *n*, and cut *s t* at a distance from the base equal to *s t* of Fig. 146. The helices upon these cylinders will develop into the parabolas shown, which under the conditions assumed will, of course, have the common vertex *s* and common axis *s t*.

This surface, it is evident, is tangent to the transverse plane containing *s r*, and extends to an infinite distance in the direction *s t*, the generatrix, as in Fig. 141, becoming more and more inclined as it proceeds, and ultimately coinciding with the axis.

A surface might be generated, having to this one a relation analogous to that between the parts of the one shown in Fig. 108 on opposite sides of the central plane *L M*, by supposing the generatrix, after coming to rest at *s r*, to move beyond *s*, in the direction *t s*, according to the same law by which its motion above *s* was governed. But it would not comply with the condition of axial expansion; our diagrams suppose the pitch to increase in the direction *s t*, and as the contrary would hold true in relation to the surface alluded to, we may dismiss it without further ceremony.

But we need not assume the initial position *s r*, of the generatrix, perpendicular to the axis. In Fig. 148, *s t* is the axis, as in Fig. 146, and similarly divided; also *m n*, *e h*, *r p*,

are the outlines of three concentric cylinders, *r p* being greater than *s t* and its divisions in the same proportion: but *s r* is not horizontal. The result is apparent—we shall obtain a surface very similar to the other, but limited by the cone of which *s r* is an element; and as shown in Fig. 149, the vertices of the parabolas in the developments will not coincide. In Figs. 149 and 151 there is a like state of things, except that *s r* is inclined the other way, of which the result is that the surface will be limited by a hollow cone, and will have somewhere a horizontal element, because the outer end of the generatrix rises faster than the inner, and must eventually pass it.

It may not be abstractly essential that we should know just where this horizontal element is, but the method of finding it involves a principle with which the reader should make himself familiar, and this problem affords a good illustration of it. The surface with which we are dealing is a warped one, and is generated by the motion of a right line in contact with three other lines, viz., the axis and two helices of increasing pitch: and we are to find the element which is horizontal. If now we take the axis and one of the helices as directrices, and slide a right line in contact with them,

keeping it always horizontal, we shall generate a new surface, which will cut the third helix in some point; and the perpendicular from that point to the axis will be the element required. This new surface, in the present case, will evidently be a right helicoid with axially increasing pitch, whose trace upon the cylinder upon which our original third helix lies will also be a helix of increasing pitch. On this cylinder, then, we have two such helices of different pitches, which will intersect each other, thus locating the horizontal element sought. But the construction may be much simplified by using the developments of these helices, the intersection of the parabolas fixing the point without constructing the projections of the curves upon the cylinders.

This is illustrated in Figs. 152 and 153; in the first we have the initial position of the element given as *s r*; in a half revolution let it rise to the position *i p*; *r e* being the radius of the outer cylinder shown. Upon this cylinder, then, we have a helix of increasing pitch joining the points *r* and *p*; now let the cylinder be cut along the right and left hand elements, and the front or nearer half be unrolled into a plane tangent along the element *c e*. This half will

Fig. 148.

Fig. 149.

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then appear as the rectangle *r f p g*, Fig. 153, on which the helix will be developed as the parabola *r p*.

Upon the inner cylinder, whose radius is *a m*, there will be traced another helix joining the points *m* and *n*. But although these two helices may, with the axis, be considered as the directrices of the motion of the element, and are practically used as such, under the names of guiding curves and shaft, in striking up the surface, we need not construct the inner one or its development for our present purpose. For if we produce *a m* to *b*, and suppose *a b* to rise to *d e*, always remaining horizontal and in contact with both the axis and the inner helix, it will trace on the outer cylinder another helix, whose development will in Fig. 153 be the parabola *m n*, the altitude *m e* of the rectangle being, of course, equal to *a d*, that of the part of the outer cylinder here employed. This parabola cuts the first one in *z*, which, by the previous explanation, fixes the height of *l x*, the horizontal element of the screw-surface swept up by *s r*, revolved into the plane of the paper. But we may do even better; the two helices as well as the axis are *practically* necessary in order to control the motion of the generatrix; but the result is that the point

s moves to t with uniformly accelerate velocity. If, then, we draw the horizontal radius sv, and suppose it make half a revolution about the axis with uniform velocity while s rises to t, as above mentioned, there will be traced on the outer cylinder another helix from v to z, whose development will be the parabola st in Fig. 153. This will also pass

of one element, which must cut the inner helix between the given planes, though it will not matter if it should not pierce the outer cylinder within those limits, because we can extend the helix on that cylinder as far as necessary. The outer helix must of course be located so as to cut this element, and we are thus able to place it in its proper position relatively to the inner one, and then we can find as many elements as we please.

in Fig. 155 the indefinite parallels xx, ww, at a distance from each other equal to st. Draw the parabolic arc ab, the development of the outer helix, as explained in Lesson XVIII, and on its project y to y'. Through y' draw the vertical line $r'p'$; this line, it will be seen, may be regarded as the side view of the right hand element rp of the outer cylinder, the plane wz being considered as tangent to that cylinder along that element. The projection of the element mn of the inner cylinder upon the plane will coincide with $r'p'$; if then we project s to s', the segment $y's'$ will be the side view of the inclined generatrix yz. The parabolic arc cd', which is the development of the inner helix, must then be drawn so as to pass through s'. This is most readily done in practice by constructing it, like the first one, between the limits ww and xx, and then copying it in its proper position. Now let $r'o$ be any fraction of the circumference of the inner cylinder, and rg a like fraction of that of the outer one, in which case we shall have $r'o : r'g :: sm : sr$. Through o and g, draw verticals cutting the parabolas in e' and k', and project these points to e and k. Then ke will be the revolved position of an element of the screw surface; and in like manner we can find as many as may be required. It may, of course, be necessary to extend the parabolas as beyond the limits at first assigned; but the mode of doing that has already been explained.

We have thus, we think ourselves fairly able to say, discussed the surfaces ordinarily used in the screw propeller, with the operations of drawing them, in a more complete and thorough manner than had previously been done. The term "screw surface" might properly be held in its extended sense to include all surfaces made up of helices of either uniform or increasing pitch. It might be made so comprehensive as to include surfaces composed of conical helices; if, indeed, these may not in a sense be already covered by the definition, since the section of such a surface by a cylinder having the same axis would be a curve which might be called a helix with varying pitch.

We believe that in the early days of screw propulsion experiments were made with such surfaces, the whole propeller being of a form like the pointed end of a wood-screw, at once suggesting the conical helix as the element. But these have been practically abandoned in favor of those resembling the ones selected for our illustrations, so that it has not seemed advisable to take them into consideration by themselves. We do not think, however, that the omission

Fig. 150.   Fig. 151.
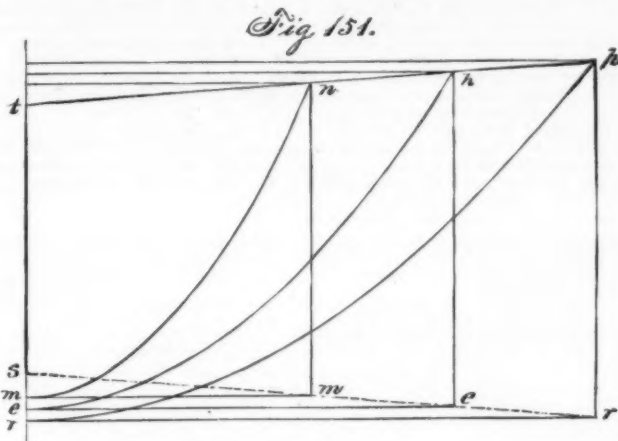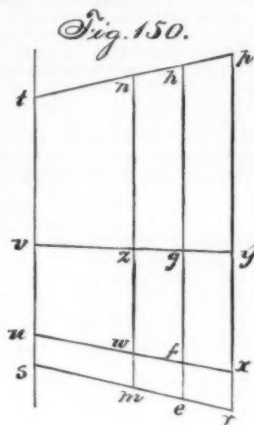
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through z, and it evidently gives a better defined intersection with rp than mn does, the angle being less acute.

Now the reader will readily see that modifications of this surface also may be made, which will result in the curvature of the generatrix. To illustrate: in Fig. 152, we may suppose a helix of increasing pitch to be drawn, starting from zero at m, but in a half revolution rising to a point higher or lower than n; and the same with all intermediate points of

tion relatively to the inner one, and then we can find as many elements as we please.

Second: In order to draw the portion of the surface to be used as the blade, we must know either the outline of the space within which the blade is to turn, or that of the blade itself in one of the projections, preferably the side view or end view; and from a knowledge of one of these things we must construct the others.
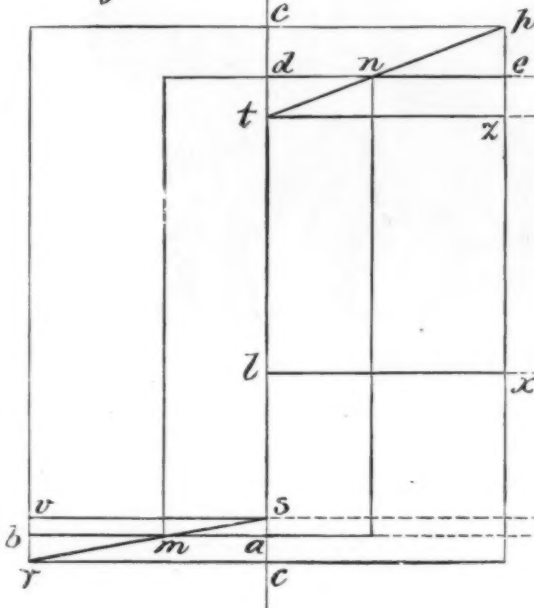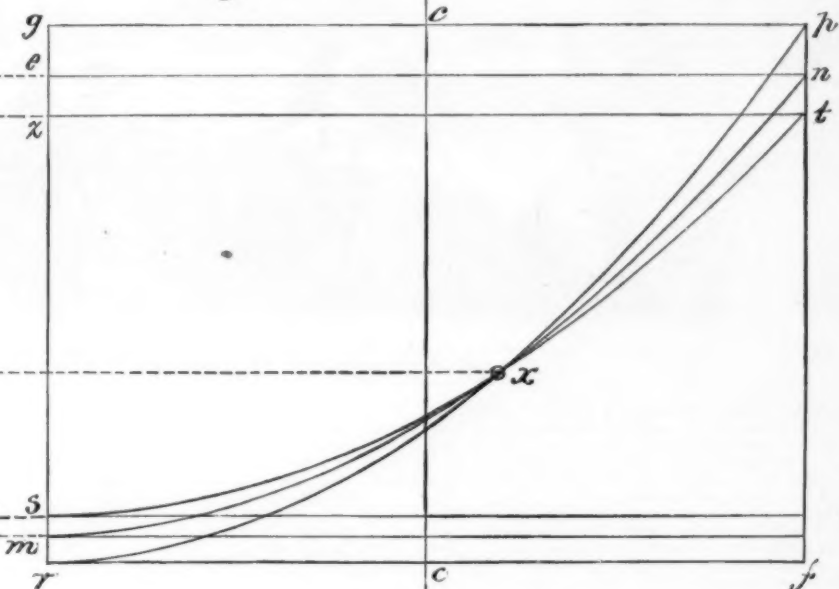

Fig. 152.   Fig. 153.

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sr. We shall then have tp, a curve instead of a right line, the resulting surface still combining radial with axial expansion, and all its sections by concentric cylinders being helices of increasing pitch, which will develop into parabolas. And if we choose, we may ring all the changes upon this theme that were enumerated as possible in relation to the preceding one. We do not think it necessary to illustrate any of them, as it needs but a moment's reflection to show that the introduction of axial expansion will not affect the leading features due to radial expansion; if the generatrix be curved at all, its curvature will change continually, so that it cannot be properly struck up, and its correct representation can be effected only by constructing a sufficient number of the helical elements, by the aid of which, however, an accurate pattern may be made.

Nor do we deem it necessary to illustrate by a detailed construction the process of drawing a propeller blade of this description even with a rectilinear generatrix, as it would involve much tedious repetition. The necessary data are as follows: First, in order to determine the surface, we must know the inclination of the generatrix to the axis at a given position, and we must be able to construct the helices traced by this generatrix on two cylinders of different diameters.

These diameters are, usually, the greatest diameter of the hub and that of the propeller itself. Usually, also, two planes perpendicular to the axis are supposed to be drawn, one at the forward and one at the aft edge of the blade at its junction with the hub. The pitches of the helices on the inner and outer cylinders are then given, at the points where they are cut by these planes, called the entering and the leaving pitch at the hub and periphery. So far good; knowing that a given pitch at starting increases by a given amount in a stated longitudinal advance, we can construct the parabola on the development of the cylinders by the methods explained in Lesson XVIII, and from that the helix itself if required, on either cylinder. But we are very often left in uncertainty, by being told "only this, and nothing more." We hope that we have made it clear to the reader that it is necessary to know, in addition, the inclination to the axis

In this surface we have rectilinear elements to deal with, and it is clear that, if we can locate these, the operations of the part of the construction will be precisely like those already illustrated by several examples. We think that those who have so followed us as to be able to draw the preceding forms of propellers, should be able to apply their knowledge in this case without difficulty. But in order to make

assurance doubly sure, we give in conclusion a diagram illustrating the initial steps of finding the elements, from the data when given in the form above explained.

In Fig. 154, let st be the axis, mn the outline of the inner cylinder (the radius sm being the greatest one of the hub), and rp that of the outer cylinder, sr being the radius of the screw. Let then, sr, tp, be the forward and aft planes respectively, and the pitches at m and n, r and p, be given; and let it be required to make the surface so that v sy, in the plane of the paper, shall be an element of it. Draw

will be seriously felt even by any reader who may wish to construct a drawing of a screw of which that helix is the element; being convinced that whoever can cope successfully with the problems themselves involved in the foregoing, will need no assistance in that undertaking.

It will be observed too that, in all the surfaces considered, the radial plane section is invariably a line, right or curved, which meets the axis. We may add in conclusion that this is not necessarily so, and that these investigations have led to some study of another class of screw surfaces, in which it is not the case.

We believe that some of these will prove well adapted for practical use in screw propulsion; but the object of these articles being not so much to explore new ground as to make a new survey of old territory, the discussion of their properties is reserved for some future contributions to the literature of this subject.

Fig. 154.   Fig. 155.

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NORTH ADELAIDE MODEL SCHOOL.

The successful progress of the British Australian Colonies is exemplified by the frequent opening of new and excellent institutions for popular education, of which the building shown in our engraving is a specimen.

This establishment was lately opened by the Administrator of the Government, Chief Justice Way.

The building has been erected on an eligible site on the north side of Tynte-street, east of O'Connell-street. It has been built from plans drawn by Mr. E. J. Woods. Though there is little attempt at ornamentation, the building is one that does credit to the architect. The school is of stone throughout, with brick facings, and internally as well as externally it has been well finished. It has a frontage of 142 feet to Tynte-street, and in the center is a small porch or lobby giving access to the main entrance, and surmounted by a bell-turret containing a bronze bell of 100 lbs. The height of the main building to the ridge is 29ft., and to the

end the girls' schoolroom and the mistresses' office. The boys' and girls' portions are exactly alike. The principal room in each case is 50 by 24ft., with stepped floor, on which are fixed 60 dual desks. Opening from these toward the south, and forming part of the front of the building, are class-rooms 24 by 22ft., with stepped floor and 24 dual desks. Opening from the same rooms, toward the north end, are class-rooms 19 by 20ft. Beyond this, and communicating with principal schoolrooms by double doors, is a passage 6ft. wide with class-room on either side 20 by 20ft., and at the extremity hat-rooms and lavatory, 47 by 10ft. One of these class-rooms in each case is also fitted with 24 dual desks, while the other two have forms on a gallery for collective teaching. The lavatories and passages are all paved with Mintaro slate, while the schoolrooms have, of course, wooden floors. Behind the school is a good playground, and a capital shed about 50 by 30ft. Both the ground and the shed are divided into two equal parts by a central partition, the one half being for the boys, and the other half for the girls and

those in surplus for the requirements for the institution are intended to be rented out for general office purposes.

The lyceum or grange room is situated upon the second floor, which contains three distinct rooms private from the principal hall. Also, a fine balcony upon one of the angles of the octagon. The building is, as drawn, 45 feet in front, exclusive of the stair hall leading to the second floor, which is 16 feet, making the entire front 61 feet. It is 60 feet in depth, substantially built of bricks, sandstone dressings. Its cost will be between 10 and 12,000 dollars. Bricks rubbed down and painted. The height of the first story is 12 feet in the clear of joists. The hall, or second floor, is 25 ft. high. For any further information address Isaac H. Hobbs & Son, Architects, Philadelphia.

STEWART'S WORKING-WOMEN'S HOTEL

IT is situated on Fourth Avenue, with a frontage of 196 feet 6 inches, and runs back on Thirty-second and Thirty-

AUSTRALIAN MODEL SCHOOL, NORTH ADELAIDE.

top of the finial on the turret is a further distance of 19ft. The entrances for the children are at the back, and the approaches to them along the sides of the school, that on the west being for the girls and infants, and that on the east for boys. The school itself is divided into three departments —for boys, girls, and infants.

Passing through the porch and main door into the entrance hall, the visitor reaches first the infants' schoolroom, 50 by 24ft., with recess fitted with a gallery, 19 by 8ft. The room is also fitted with forms and desks. On the opposite side of the entrance hall is a babies' room, 30 by 24ft., also fitted with a gallery and low stools. Next comes a corridor 6ft. wide running along the whole length of the two infants' rooms, from which open near the centre the hat-room and lavatory for the infants; and from the eastern end the boys' schoolroom and the master's office; and from the western

infants conjointly. The whole area occupied by the school, outbuildings, and playground only includes one acre of land. The total cost, including site and furniture, is £9,234, and the school will accommodate nearly 1,000 children.

During the month of August last, 1,037 children were in attendance, and, as up to the present time no child has been refused admittance, the school may be said fairly to supply the wants of the district for which it was built.—*Illustrated Adelaide News.*

DESIGN FOR LYCEUM OR LIBRARY.

THE above is a design suitable for a grange, lyceum, or library building. As their wants are similar, it is two stories in height; the first story is intended for offices, etc.;

third Streets respectively 205 feet, covering a total area of over 40,000 square feet. It is six stories high with an additional mansard story, and along the front for a width of 100 feet the mansard is raised a story, making in this portion an eight-storied building above the curb. Nothing is seen exteriorly but iron, glass, and slate. The height from sidewalk to main cornice (six stories) is 90 feet. The mansard adds 12 feet, while over the central portion of the front the external height to the mansard curb moulding is 109 feet. The main entrance is on Fourth Avenue, and is 48 feet in width, and is emphasized by a two-storied portico, with clustered iron columns; and an attempt at lightness has been made in this feature, which only makes it the more out of keeping with the heavy mass to which it is attached. The block plan shows an inner court 94 x 116 feet, at the center of which a fountain with basin 18 feet in diameter will be placed. In addition to this, several ventilating shafts 8 x 12 feet are provided. The vestibule within the grand entrance is very roomy, and leads to a hall 30 feet wide, from which the main staircase rises with double flights, and between them runs the largest elevator: there will also be two other passenger elevators, with a pair of freight-lifts at the rear end of the building. The first story, 19 feet 6 inches in the clear, will be fitted up as stores; of these there will be twenty-four, each 52 x 17 feet. The basement floor is 14 feet below the sidewalk, and will be given up entirely to the engines and furnaces. Vaults for coal extend below the sidewalks on the three sides of the hotel, while a dozen or more boilers will furnish the steam for heating the entire interior, for driving the elevator engines, for furnishing pow-
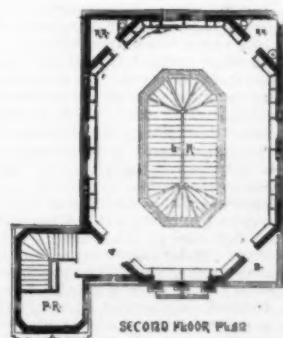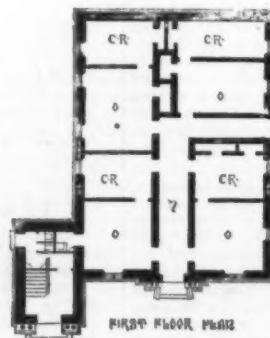
DESIGN FOR LYCEUM OR LIBRARY.

er to kitchen and laundry, and for working the ventilating fans, as well as pumping water to the two great water tanks each of 13,000 gallons capacity, situated in the mansard story. From these tanks the entire water supply for the upper part of the building will be drawn. In the rear of the first floor, the laundry and kitchen are arranged; and, if report be true, some wonderful quantities of provender are to come from the regions of the *chef*. Some idea may be formed of the scale of preparation, when for griddle-cakes alone an iron griddle 7 x 13 feet and one inch thick has been set. This expansion of the kitchen facilities is because of a plan of giving out lunches and ready-cooked dinners to girls and others not living as guests in the hotel; and for this a room 50 x 20 feet on the ground floor, at the Thirty-second St. flank, will be used. When in full working order, it is calculated that daily meals may be furnished to four thousand people. The second story of the building is 16 feet high, and will be given up to the common uses of the hotel occupants. Here will be the dining-hall, the grand parlor, the library and reading-room, and the concert or assembly room, each 55 x 100 feet. 600 guests may sit down to dine at the same time; and in the fitting up of the other apartments the utmost care has been taken to have the surroundings and furnishings on a scale of elegance and cost commensurate with the size of the whole. These rooms with the other private parlors and rooms on this floor look into the inner court, and open as well upon the outer streets. The passages and halls of the first and second floors will be tiled in marble, but the rooms proper will be carpeted ; and over 15,000 yards of Axminster, Wilton, and Brussels have been used in the several rooms throughout the building. The third, fourth, fifth, sixth, and seventh floors are cut up for the uses of the lodgers. There are 502 private rooms; of these 115 are double rooms, each 16 x 18 feet area, while the 387 single rooms are half this size. All are furnished in good style, and each room has hot and cold water-taps, gas, and electric bell communication with the office. Bath-rooms and water-closets are provided in abundance. In all respects the building represents the best material, put together with the best workmanship. The building is technically fire-proof; that is, it has heavy brick bearing walls, iron beams, filled with brick arching, and overlaid with cement bedding for the tile or hard-wood flooring. The partition walls are built with iron studding, iron laths, and plaster. The bald look of the interior is relieved as far as possible by a judicious use of works of art, and the arrangements will compare more than favorably with the best hotel in the country. Altogether the pile is a magnificent monument. If the plan of gathering together a thousand irresponsible young women into a single home shall meet permanent success, the Stewart Home will be a blessing.— *American Architect.*

THE SOUTH PARK MINES.

STAFF CORRESPONDENCE OF THE ENGINEERING AND MINING JOURNAL.

THE South Park was one of the first portions of Colorado entered by the prospector. When the gold excitement at Hamilton and Buckskin died out, by reason of the exhaustion of the richest ground, the Park was deserted except by the hunter and ranchman, and remained so till 1870, when the first silver discoveries were made on Mounts Lincoln and Bross, at the extreme northwestern corner, where the Platte, Blue, and Arkansas rivers find their source.

The Mosquito Mines, as these are called, being located in a spur of the main range having that name, and which forms the western wall of the Park, and the divide between it and the Arkansas Valley, have developed with moderate rapidity during the last seven years. They were the first precious metal deposits found in the State (excepting placers) which did not occur in fissure veins, and, consequently, received at the first only a small amount of attention. As soon, however, as it became apparent that their production showed a steady increase, and that additional developments rapidly improved their condition, confidence became established and capital took hold. From that date, although with no remarkably rapid strides, the district has advanced, until it occupies a prominent position among others in the State. When the argentiferous lead ores of the California gulch were discovered in 1876, this part of Colorado began to experience a much more rapid growth. Oro City and Leadville are now places of note, and during the two years of their life have developed more ore than any other locality in the State. They are located on the west slope of the Mosquito range, yet belong to the South Park district, and may fairly be considered under the same head.

The Mosquito Range is made up almost wholly of limestones and sandstones of the Silurian age. Nearly all are highly metamorphosed. Perhaps the best section of the formation is found on Mount Lincoln, whose base is the Potsdam sandstone (quartzite), and whose crest is crystalline lime, overlaid in places by trachytic porphyry. Between the two are numerous narrow stratas of lime and sand rock, ranging from 30 to 100 feet each in thickness, and aggregating about 2,000 feet. Granite appears at several points on the extreme upper and northern parts of the range. Porphyritic overflows and dikes are very frequent. For a distance of 30 or 40 miles north or south this may be regarded as a rough outline of the local geology. The dip of the stratifications is to the southeast, and their strike, consequently, is about southwest and northeast.

TWENTY MILES OF CONTINUOUS GOLD WASHINGS.

The complexity of the formation, which is heightened by numerous deeply cut and tortuous lateral gorges, enormous erosions, and extensive porphyritic overflows, has given an opportunity for the occurrence of nearly every variety of metalliferous deposits known. At the head of Mosquito and Buckskin gulches are fissures in granite. Lower down one finds contact fissures between granite and quartzite. Entering the sedimentary rocks, the lowest quartzite (which is probably 2,000 feet in thickness) is found to be full of gash veins, carrying generally rich ores of gold. The upper crystalline beds furnish segregations of silver ores and chimneys of lead minerals; and lastly, in the order of their discovery as well as in that of their probable deposition, are the horizontal bedded veins of California gulch, yielding oxidized ores of lead and iron rich in both gold and silver. Wherever the topography of the country has so favored nature that heavy erosion and disintegration could proceed, enormous areas of placer ground have been deposited. In fact, almost every foot of ground along the base of the northern 20 miles of the Mosquito Range is auriferous to an extent that will render the working of the entire deposit profitable. Large areas of the most advantageously located bars are already being washed with great success. When it is further stated that nearly all the rock mining ground of the South Park district is located above timber line (11,000 feet above

the sea level), and that none is lower than 9,000 feet, the reader's imagination will enable him to comprehend to a great extent the prominent features of the locality.

THE HIGHEST MINE IN THE WORLD.

The Moose Mine, located nearly on the culminating point of the range, is at present the highest mine being worked in the world. Its boarding and living houses for the miners are built into the mountain at the mouth of the mine, considerably over 14,000 feet above tidewater.

There are two direct ways of entering the South Park from the Plains at Denver. One may take the D. S. P. & P. R. R. to Morrison at the base of the mountains, from which the coach line leads for 90 miles over hill and dale through beautiful scenery, and along the northern edge of the Park to Fairplay, which, as far as it is possible, is the central community of the district. Or by going southward on the Rio Grande road to Colorado Springs another coach road is found whose route leads up through the beautiful Ute Pass just west of Manitou, entering the Park at almost the center of its western border, through which a fine road leads to Fairplay. The latter road is perhaps the best and most comfortable; and it is to be understood here that your correspondent paid his way in cash, and is not paying for his ride by this notice. The distance of staging is equal in both cases.

FAIRPLAY.

Fairplay is built on the northern banks of the South Platte. The steep bluffs across the run—(here not more than a creek)—are well stocked with gold dust, and several miles of the plateau which stretches along the river are taken up and worked by the Fairplay Gold Mining Company. The ground is not very rich, nor is the grade heavy, so that white men do not find many inducements to work the gravel. The company has, however, imported quite a colony of Chinamen, who regard the ground as the biggest kind of a bonanza, and during the short season of summer extract many an ounce of shining gold from its unpromising sands. They work under lease. The company houses them and sells them food and clothing at its store, where there is a Chinese clerk to fill their orders.

Beyond this mine Fairplay presents no attractions to the stranger. The town was burned to the ground in 1873, and has been rebuilt after a shambling, desultory fashion, strongly suggestive of hard times and a close market for paint. It is, however, the county seat, and, therefore, the place where mining men meet to fight over their titles, and where the lawyers congregate to worry the judge and wrap around still more closely the heavy cloak of mystery which encircles our national mining law, and makes it a terror to well-doers and a blessing to the other class. Passing through its broad and quiet streets, one follows the Platte for seven miles upward, having in view nearly all the way the towering mass of Mount Lincoln, and finally reaches Alma, a little hamlet at the base of the mountain, which, in reality, is the mining camp of the eastern side of the Mosquito Range.

ALMA.

Here is the branch establishment of the Boston & Colorado Smelting Works, a matting establishment only, where the ores are concentrated to a value something over $1,000 per ton. The product is then shipped to Black Hawk for separation. Alma rests at the mouth of Buckskin gulch. A few rods above its mouth is Grose's Concentration Works, which has turned out during the year about 90 tons of dressed ore. About half a mile still further up is the abandoned town-site of Buckskin. In 1860 there was half a mile of saloons and faro shops on this spot, and a couple of thousand miners, shoveling bedrock into the rich gulch and boring into the bowels of the noted Phillips lode, which crosses the gorge above the town, 30 feet in width. To-day almost the only relic left is a shattered and tortured treasure-box which started out of the gulch one morning on board of one of Wells, Fargo & Co.'s coaches, with its insides well lined with glittering dust, and fell among thieves during the following night. The balance of the town has evaporated, and the famous Phillips lode is reduced to the ignominy of furnishing iron pyrites as a flux for the smelting works below.

Opposite Alma lies the Mills and Hodges placer ground. The Platte in paleozoic times once carried a broad and deep channel where here is now a gently sloping plateau. The gravel deposit is 50 to 70 feet deep, and carries from 30 to 50 cents in gold to the yard. It is worked by several hydraulics, which are gradually eating their way into the deep banks, but the ground is good for several scores of years. Further description of this property will be reserved till we can finish the sketches with which to illustrate it.

MOUNT LINCOLN.

The ascent of Mount Lincoln in the winter is an undertaking of some labor. One has only to look upward at the great white mass, over which the wind sweeps in continuous gusts, raising great whirls of snow, which carom along the steep slope for hundreds of yards at a time before they are swallowed up by a deep ravine or dissipated on a tall crag. Can one mine up there in the winter? Alma is 10,000 feet above the sea. There is only a narrow fringe of timber, 1,000 feet wide, above it, and then comes 3,000 perpendicular feet of bare rock, so steep that the loose rock will scarcely cling to its side. But a glance through a glass, at almost any time of the winter, will reveal a train of hardy "burros" climbing up to the silver mines or returning heavily laden with ore, or a horseman or pedestrian, beating his way against the fierce storms. There is no better proof of the value of these mines than the energy with which they are worked.

The road leads up through Alma, along the base of the hill to Dudley, where are the offices and reduction works of the Moose Mine. A little above here the path turns abruptly to the left, and you begin the ascent. So long as timber holds out the way is easy. You follow a well-graded wagon road, and experience considerable comfort in the thought. The pine and spruce rapidly thin out, however, as the brow of the first bench is reached, and you wrap around you all the covering which Providence and forethought have provided, and commence business. For awhile the mind can amuse itself in endeavoring to trace the footmarks of the "burro" train which began the ascent an hour before, but, as a rule, the lack of success which attends the effort becomes discouraging in a short time, and other subjects are sought for. If you are a humane man, you generally dismount about half way up, and lead your horse, and experience in the act not only a moral but a physical satisfaction. If, however, you belong to the unregenerate, you endeavor to keep yourself warm by hammering his flanks. In either case progress is slow. It is a weary pull. The way leads

up, up, across dazzling fields of snow set on edge, across wind-blown patches of limestone chips, where the foot slides at every step, still upward in the face of the blast loaded with a million little ice crystals to the square inch, which would almost shave a man if permitted, till at last a camp of half buried shanties is reached which mark the openings of the Dolly Varden Mine. Everything is closed up tight. Not a worker is to be seen. They are all hidden away in the heart of the mountain, and though the appearance of human habitations apparently so untenanted is somewhat dispiriting, yet it is otherwise encouraging to the traveler, for he knows that at last the edge of the metalliferous limestone is reached. For the Dolly Varden Mine is on the same belt as the Moose.

Winding along upon the slope, the road at last takes a turn to the left around a sharp point. Here the wind is at its best, and bowls its way against you at any rate which a lively imagination or an anemometer can suggest. It is a short pull, however. Another collection of snow-bound buildings appears snugly set into the mountain side, on the edge of a deep ravine, and in a minute after a final struggle with the blinding storm you find shelter in Superintendent Hill's office, when the consoling fact is learned that the thermometer outside stands 18° below zero, and the wind gauge records 40 miles an hour.

Once under shelter it becomes easy to see how mining is carried on at this altitude. All the buildings for the lodging and feeding of the miners, for the ore dressing and loading, are built directly at the mouth of the mine. They stretch along the mountain side for several hundred feet, for the mine is opened at 14 points. The miners step from their sleeping rooms and mess hall directly into the mountain. The pack animals are loaded in a long shed built at the mouth of the tunnel, and if it is necessary to dump a load of rock a door is pushed aside, and with a short run of a score of feet the car is carried to the edge of the precipice, where its contents may travel 3,000 feet if they choose before striking permanent bottom. But this is now seldom done, for the great chambers which were once full of ore furnish ample room for thousands of tons of waste. In the superintendent's office the click of the telegraph is heard. A line reaches from here to the reduction works at the base of the hill, and a telegram may be sent to London or New York at any time you choose to pay for it. Mr. Gill, the manager, is about to put in a telephone between the mine and the mill this winter, which will doubtless prove a vast convenience.

THE MOOSE AND DOLLY VARDEN MINES.

Being now on the metalliferous belt of the range, one very quickly becomes more interested in minerals than in storms. This limestone cap to the mountain is probably from 20 to 30 feet in thickness. It is a blue lime of a highly crystalline character, and explorations at the Moose and Dolly Varden have shown that it is filled with chambers of silver ore placed with little or no regularity or method, and displaying hardly any visible connection. The gangue appears to be mainly of heavy spar, with some calcite. Prof. Richardson advises me that the former in the dressed ores will average about 16 per cent. The ore itself is sulphuret of silver, associated with some galena and zincblende (2 to 7 per cent.), a little copper, and much lime. Once inside of the mine the points of the compass rapidly become involved in inextricable confusion. Gallery after gallery is passed through; immense chambers from 6 to 30 feet in height, and from 10 to 150 feet wide or long, are crossed; the way leads up and down in every direction, and in a short time but two conclusions can be reached by the observer: first, that an immense amount of ore must have been taken out in the past, and second, that no accurate idea of the amount in sight can be formed without a most careful instrumental survey. After seeing a few of the great chambers that have been cut out, one's natural distrust of limestone deposits is forgotten, and all the more easily after taking a glance at a few of the ore breasts. At the Moose fifty men are at work, and half as many at the Dolly Varden. These are the only two mines on Bross which are at work during the present winter. Across the ravine on Lincoln, the Russia, Ford, and Lincoln are working to a small extent, but only the former two are fitted up sufficiently well to carry on operations during the fierce winter. As the *Journal* will contain before spring complete illustrations of the Moose property, it will be premature to enter into details in this article. The general impressions one carries away with him after visiting the mine are that it is being worked in an excellent manner, that it is developed to a point where continuous and steady production may be carried on, and that the ore produced will pay excellent dividends on the stock. These impressions are heightened on an examination of the plan of the reduction works at the bottom of the hill, where extensive additions in the way of roasting and chloridizing machinery are being made. The management of the mine is all that could be desired. It is apparently in the hands of honest business men.

The process in use at the reduction works (which, by the way, are only used for third grade ore, the higher grades being sold to the smelters) is roasting, chloridizing, and amalgamation. As the ore is a heavy lime-rock, great difficulty was at first experienced in amalgamation, but this trouble has been thoroughly overcome by Mr. Tobie, the superintendent of the mill, and unusually satisfactory results obtained. These will also be presented in detail in connection with engravings of the mill.

After seeing the Mount Lincoln and Bross Mines, there is still left much of interest in the district, though during the winter but a very few mines are worked. At this high altitude the most careful and thorough preparation against storms is absolutely necessary to insure economical working the year round, and, as yet, few of the mines are opened sufficiently.

The Champion in Mosquito Gulch is one of the most promising mines of the district. It is a contact vein, and is opened by adit levels, which have penetrated above 150 feet into the hill. Substantial buildings have been put up, and three main adits, one above the other, driven. The ore is of high grade, carrying both gold and silver, and milling $150 to $200 per ton.

The Dolly Varden is stoping out its usual quantity of high grade ore. But little can be said of the mine, except that it holds its own so completely as to force confidence in its future. Its workings are in all respects similar though not so extensive as the Moose.

Down the gulch from Alma to Fairplay is a cold and dreary ride. From Fairplay the road leads across Weston Pass to California Gulch and the lead mines, 40 miles west.

AMERICAN versus ENGLISH LOCKS.

WHAT AN ENGLISH WORKMAN THINKS

THERE is something more to be said on this subject, treated of in the *Furniture Gazette* for October 27th, and that not from a manufacturer's, but from a workman and builder's point of view. Very glad, indeed, shall I be to find the English maker holding his own against the American locksmith, but to do this it will be necessary for him neither to despise nor ignore the lessons taught him by his competitor on the other side of the Atlantic.

As a workman, I have been called upon to fix almost every kind of English-made lock which is used in a dwelling house; as a builder, having hundreds of houses to keep in repair, I have been constrained, times without number, to anathematize the makers of the miserable combinations called English locks.

In making a fair comparison between English and American locks, we have to lay aside (if we can) our prejudice against the foreign production, and consider the articles in reference to, first, their price; second, their adaptability; third, their durability; and fourth, their security.

Let us take the American 4-inch rim lock, which is the article that competes with the 6-inch English rim lock.

The American lock, neatly packed in boxes with the furniture (of which more presently), costs complete about 1s. 9d. retail to the builder. Nothing of English make, except some abortion which cannot be called a lock, can be bought under from 2s. to 2s. 3d. An American mortise lock, which lies before me, costs 2s. 11d., including furniture, while an English one of the same grade costs 2s. 9d., without furniture; so that in the matter of price the advantage is on the side of the American article.

Next as to their adaptability or fitness for the purpose for which they are designed. The American rim lock is only half the size of the English one, it is neat in design, takes less trouble to fix, can be reversed in a moment from right hand to left, and is quite as heavy and strong as is necessary. This quality of reversibility, though it may not be of much importance to the cabinet maker who is always within arm's length of his store-room, is of great advantage to the builder, who may find, after sending a number of locks a good many miles, that, in consequence of mistakes or alterations in the hanging of his doors, two or three of his locks are "wrong hand." I know I shall be told that English makers supply a reversible lock; but I answer, "Not in the ordinary way of trade." If I want an English lock to reverse I must pay specially for it, whereas the American maker seems to consider the reversible bolt arrangement to be as much part and parcel of an ordinary lock as is its keyhole. There is no cutting of the door edge required in fixing an American rim lock, and I am at a loss to know why it should be required in the case of the English one, for I have never yet seen any earthly necessity for the projecting flange which has to be let into the door edge; it adds nothing to the security of the door, it receives no strain in any attempt to force the door from the outside, and it certainly does not add to its beauty.

The staple of the American lock is of cast iron, made to match the lock itself, and is no larger than is required for the work it has to perform. The plates which cover the lock, having slight projections or bosses cast upon them, give a much better bearing to the "follower" than the sheet iron casing of the English lock of the same class. The English makers seem to throw away an amount of labor in unnecessary work and material, while the Americans seem to strive to economize both.

The English rim lock which lies before me weighs nearly twice as much as its Yankee competitor, the keyhole is plated with brass on both casings, and the brass is polished; whereas, if the brass had been used to bush the follower, where most of the wear of the lock is, it would have been to the advantage of the article.

The edges of the lock which lie next the door, and consequently out of sight, are polished, an economic sin which Uncle Sam would not have committed. The same may be said of the edges of the feather spring and other portions of the internal part of the lock. The staple is of the ordinary English type, half an inch wider than is necessary, with a piece of brass riveted on the edge, to receive the latch. Only those who have to contend with the repairs know the annoyance caused by these miserable things, which are forever breaking off, to the detriment of lock, door, casing, and the temper of both tenant and landlord. Indeed, years ago, before ever an American lock was introduced into the English market, I insisted upon being supplied with a cast-iron box-staple for all our drawback locks, finding that it was cheaper to pay for an extra staple than put up with the annoyance and loss caused by the ordinary one.

Much the same may be said of the mortise lock. The Americans make a lock in which there is nothing superfluous, while the English manufacturer seems to delight in grinding and polishing up the outside of a lock, which is never seen after it is fixed. Why, in the name of common sense, need there be labor wasted in polishing up the body of a mortise lock, which is concealed from human eyesight from the moment it is fixed, unless it be taken out, years hence, to be repaired, when the chances are it will be thoroughly rusted? Now a word or two about the furniture. The American makers supply a set of furniture with their rim locks formed of some mineral composition so strong that it can be thrown for a considerable distance without injury. The shape is rather different to ours, but the grip is much better. The roses have teeth cast on the side which fits to the door, to prevent them turning with the spindle. Each spindle carries six small washers, which serve the double purpose of taking up part of the slack and diminishing the friction. One knob is firmly fastened on the spindle, the other carries a screw which is long enough to screw into the spindle, and the spindle is tapped to receive it. Contrast this with the English furniture.

Here we have a spindle carrying two brass knobs, each knob consisting of two parts, a neck into which the spindle is roughly fitted, and a hollow shell which grips the neck and forms the handle; and, as everybody knows, is likely at any moment to turn round in one's hand. The screw is tapped only into the neck, and has a round end which enters a countersinking in the spindle; and, as before, everybody knows the result, the knob soon works loose, the screw drops out, and the unfortunate builder gets the blame.

Next as to their durability. I am strongly of opinion that a few years' wear will prove that the American locks will contrast favorably with our own in this particular. Now a word about their relative security. Let some of your readers take, say, fifty English locks of the class about which I am writing, and they will be surprised to find how many of the keys will "pass." Take the ordinary drawbacks, say at 3s. 3d. each, and try a street of artisans' or clerks' houses, and the tenant will be horrified to find how many of his

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neighbors could open his front door if they chose. The small rim or mortise lock, of which I am writing, is only for the inside of our dwellings, and we seldom lock our inside doors except against our children; and even if we did, an American lock would be quite as proof against a skeleton key as would an English one, and neither of them would stand any chance against the burglar's usual picklock, the "jemmy."

There is no manner of mistake about the quality of the castings, and English manufacturers may hang their heads with shame when they look at castings which are almost as smooth when they come out of the sand as their own work is after it has been ground. How it is I know not, but it is a fact that to an English eye these castings are marvels of cleanness, and we shall do well to set our house in order, or we may find ourselves beaten on our own ground. I shall be glad to see English goods maintaining their position, but it can only be done by leaving, to some extent, our old beaten tracks, and improving our modes of manufacture.

For the present, American goods have to contend against our prejudices, the separate prejudices of proprietor, builder or architect. Locks are a class of goods sold mainly to certain classes of the community, and these classes have often conflicting interests and prejudices. Thus, the builder will not lay in a stock of American locks, lest the architect under whom he works should condemn their use; the architect is afraid to specify them, lest, if they should get out of order, the owner should blame him.

Of course, for all locks where absolute security is required, nothing can equal hand-made goods. But, if we only think of it, how few of our mortise or rim locks are ever actually used as a defense against thieves, and how slender would be the defense even if relied upon.

It will not be wise for the ironmonger to flatter the hardware manufacturers with the notion that they are masters of the field. It would not be amiss if they would take a few builders into their confidence, and get them to point out some of the defects in their builders' ironmongery, with a view to placing themselves once more at the head of the hardware trade, for they must keep their eyes open, or they will be beaten with their own weapons.—*Furniture Gazette*

REAL AND MANUFACTURED ORNAMENT.

THAT superfluity of ornament covers a multitude of defects may be accepted to be as trite a maxim as any dictum of the moralist. "Assume a virtue if you have it not," seems to be a modern precept of art among that large class of architects and artists who appeal to an impressionable public rather than to a cultured taste. There is a far too prevalent notion that art is merely skin-deep. It is a comfortable notion, exceedingly agreeable, and quite in unison with the commercial spirit. A house or a shop front, a piece of furniture or a book-cover commands, other things being equal, an appreciable increase of value in the market, if it have a little embellishment beyond its unadorned competitors. Speculative builders, furniture-makers, and manufacturers generally, find a little carving, color, gilding, or embossing highly remunerative, and often that an inferior article pays better for the gilt.

Utilitarian as the Englishman is, he is obliged to acknowledge the supremacy of that innate love of ornament that seems as keen a sense with the primitive savage as with civilized nations. Notwithstanding the fact, established by the philosopher, that in order of time decoration has preceded dress, and that the idea of adornment has predominated over that of use, we have yet in our advanced age to account for the continued power of the art that still administers as keen a pleasure to the civilized being of the present day as the tattooing with bright pigments does to the Orinoco Indian. It is only when we seek a little deeper that we discover the distinguishing test that separates the simple sense of children and savages from that of educated men. The ornamentist soon perceives the preference of the first for strong stimulants and bright colors, and of the latter for subdued tints, neutral colors, and avoidance of harsh contrast. Watch the attention of the masses of our sightseers in street pageants and our picture galleries, and mark the admiration bestowed on brilliant costumes and tawdrily-colored paintings. It is art instinct of a low type.

Not so easy of discernment is the difference between the appreciation of bad and good architectural ornament. It is not a test of bright color or strong contrast, but rather a discrimination between the kind and degree of ornament employed and a just or excessive use of it. It is a question of motive, quantity, as well as quality. The subordination of ornament to structure is a condition of its employment that is painfully disregarded. If we look at a piece of furniture —say a modern sideboard or pianoforte—we find in ordinary cases the carving either in the wrong place or so diffused that we lose entirely the meaning of the work. Its lines are so twisted and convoluted that we are forced to take cognizance of the ornament first, and afterward of the use or purpose of the furniture. The evil has partly sprung from the use of manufactured and composition ornament, or the application of the "stuck-on" principle which has become so general in some classes of manufacture that the art workman uses it with as much complacency as the victualer adulterates food.

Ornamentation may be broadly distinguished as structural, superficial, and colored ornament. The first belongs to the architect *par excellence*, and its honesty and thoroughness are the first consideration. As Pugin remarked of architecture, there is a wide difference between decorative construction and constructed decoration. The latter is the system of the manufacturer of meretricious art, the former that of the architect. It is necessary, also, to understand that there is a great difference between "ornamented" and "ornamental" construction. The former is the system which not long ago was seriously promulgated by a professor of art at the Architectural Association. It means simply this: To get an engineer to design a bridge or a structure of any sort, and then let the architect add ornament thereto in any way consistent with it. Now we believe this is a very common idea among some members of the profession. It is, at any rate, the idea most in favor with the manufacturing decorator. It is a facile, expeditious, and costless way of designing. It is the speculative builder's idea of architecture.

Our American cousins carry this system to extremes. We lately had a thick folio sent us from a well-known Philadelphian firm under the euphemistic title of a "Manual of Architectural Sheet Metal Work." Many of our readers will smile at the name, and will be curious to know its contents. Well, the work in short gave rules and tables to estimate and design every part of an architectural building from basement to roof—door and window dressings, cornices, pilasters, and every architectural ornament in sheet metal, manufactured to every conceivable style — by the K— Cornice and Ornament Co. Here the architect has at his hand a com-

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plete assortment of brackets, balconies, trusses, window architraves and cornices, moldings, friezes, pediments, dormers, crown moldings, crestings, etc., from which to pick and choose at his discretion. The book further gives him means and tables to estimate to a nicety every form and size of feature he may require, and supplies details, and a profusion of illustrated examples, to aid him. To give an example:

An architect wants a main cornice; he selects a type, prepares an elevation and plan to scale, giving the heights and projections of the various members. Upon these the manufacturer identifies the different parts and ornaments, the brackets, modillions, and frieze pieces, and writes the names of the moldings, numbering them for reference, the said numbers representing the profiles (stays as they are called in manufacturing parlance) kept in stock. Usually, however, the manufacturer supplies these drawings himself, and they are sent with a shipment of the goods. But there is another drawing prepared of a section of the cornice, and our readers will be interested to know that these cornices are supported by brackets or frames from the wall called "lookouts," and that the said section is, therefore, in American terminology, a "look-out section" or profile. In fact, a cornice of this sort bears considerable likeness to a wooden shop cornice among ourselves. The look-outs or brackets are usually of wood, to which the galvanized iron moldings are fixed, but large and fire-proof cornices are constructed upon bar-iron supports and braces, which give the general contour. The moldings of sheet metal are attached by means of button-headed bolts, and modillions are attached by riveting. Anchors or ties passing through the wall, their ends bent down for a fastening, secure these metal supports and the center cornice.

Thus it is our Transatlantic brethren construct the ornamental features of many of their buildings, and thus it is the workman "puts up a cornice." Much is left to the discretion of the factory, and the forms and profiles are often varied to meet the mechanical requirements of the manufacturer. The architect often sends his elevations, or copies of them, to the factory, and the detail is entirely left to it. To select a few of the structures of recent erection of sheet metal work, we may name the New Court House, at Van Wert, Ohio (1875), entirely covered with metal ornament: in fact, we are informed the whole exterior finishing, from basement upward, is of galvanized iron, with pressed zinc trimmings. Our readers will be amused to hear that these include string or belt courses, quoins at angles, window dressings, main cornices, balustrade, dormer windows, and mansard roofs. The walls are of pressed brick. We are told with amusing *naïveté* that the quoins are constructed "of cushion-pattern crimped iron, presenting a close appearance to cut stone," that the sheet-metal work is painted and sanded, and cannot be told from one of stone. We are further informed that the critic will find nothing lacking in stability, solidity, or durability, while the taxpayers of the country have an edifice of which they are justly proud. At Erie, Pa., Baltimore, New York and many other towns the same species of ornament is used.

We feel, however, that the sentiment above expressed will not be shared by our countrymen. We have here, at least, an instance of ornamented construction. At home we find numerous examples of this same kind of art—perhaps not so glaring and honestly-avowed, but still quite as pernicious. It is for architects to show the public the difference between good and false ornament, to show the dishonesty of cast cement and composition enrichments by contrast with well-conceived ornament. If we designed ornamentally—that is well, simply, and gracefully—we should soon give a tone to our work. The popular mind would immediately discern the difference between the real and counterfeit coin, much as it can now distinguish between gold and tinsel. Let it be once understood that all structural ornamentation is simply the correlative of building, or, in other words, the art of structural expression—that it really implies building in its right place in the same manner as we speak of good composition as writing with elegance, in which the rules of logic, syntax and rhythm are observed—and we shall do much to dispel the false and popular notion that ornament is something added. It is this superfluous idea of ornament that has placed ornament in so low and false a position. Such a thing as manufactured ornament should be an impossibility.

When we turn to the other kind of ornament named—the superficial or surface, and the colored—there is perhaps less evident connection between it and structure. We have no room here to lay down the limitations that should be imposed with regard to this species of ornamentation, though Ruskin's idea has always impressed us as embodying the correct principle—namely, that where the eye can rest there we may decorate. It would be almost supererogation to say that the violation of this principle is the general cause of failure. Look at the speculative builder's gimcrack embellishments; see where he places his carving and incises his ornament—not on plain wall surfaces above the level of the eye, but on his window lintels, and round his arches—everywhere, in fact, but the right place. Paraphrasing a well-known motto, we may define true ornament to be form in its right place, while manufactured ornament is decoration out of place.—*Building News.*

A CORRESPONDENT of the *Chemical Review* says he has tried many recipes, etc., on aniline black, but has invariably come to one conclusion, viz.—that no aniline black can be produced on cotton skeins which depends upon the action of muriatic acid and heat in the ageing room for its development, as cotton dried with strong acid in the fibre must be destroyed, and asks whether this difficulty has yet been overcome, viz.—the production of aniline black on cotton skeins without heating or ageing off the acid.

FIXATION OF INDIGO UPON TISSUES.—M. Prud'homme, after giving a brief summary of the present methods of fixing indigo upon tissues, says: "We have recently discovered a new method of fixing and reducing indigo, which, without great practical use, presents nevertheless some interesting peculiarities. A mixture of glycerin, carbonate of soda, and protoxide of tin, in a paste, reduces indigo perfectly at about 120°. If water is used instead of glycerin, the reduction is incomplete."

THE Manchester Chamber of Commerce have on exhibition at their offices a sample of fiber made from the leaf of the pine-apple plant. It has been sent to this country by the Governor of the Bahama Islands for examination, with the idea that it may be usefully employed in manufacture. The sample is about a quarter of a pound in weight, the produce of 305 leaves, and is described as being "somewhat of the nature of jute."

USE OF GLYCERINE IN WEAVING, DYEING, PRINTING, AND FINISHING.
By M. H. HERBERGER.

ALTHOUGH glycerine has long ago found industrial applications, and though it is used in certain large establishments where the practical advantages which it offers are fully recognized, we still find people who are afraid of a substance so valuable in dyeing and printing, or who, at any rate, have no knowledge of its utility.

Glycerine, in the first place, is one of the best lubricants for the moving parts of machinery, especially for such as are exposed to the air or to alternations of temperature. It neither thickens nor turns rancid, nor congeals in winter nor dries up in summer. If pure glycerine is not desired, it may be mixed with half its weight of olive oil. It does not attack metals as do many oils which, to give them weight, are sophisticated with acids (?)

It is also very useful for printing colors on woolen, because before steaming the colors thus printed are kept in a permanently moist state. For printing colors on cotton it is employed to accelerate and increase the oxidation of the mordants before topical dyeing.

For dissolving aniline colors, 3 parts of alcohol at 88 per cent. are digested upon the dry color, and 1 part of glycerine at 28° B. is then added. On thickening with albumen and analogous bodies the glycerine opposes the precipitation of the aniline colors, and is the best agent for keeping them in perfect solution.

For articles soluble in water, sizes, finishings, colors or mordants, 1½ oz. of glycerine may be added to every 35 fluid ounces.

For dyeing, printing, and finishing, glycerine does not require to be white, and is as useful if of a pale yellow, when its price is much lower. It is only for the most delicate colors, such as ultramarine, that a white quality must be selected.

black lead, and then given a coat of green lacquer used for that purpose, which can be purchased of any of the lacquer-makers.

DYES FOR GLOVES.

HAVING had several inquiries from our correspondents for methods for dyeing gloves, we subjoin the following receipts:—

WHITE.

The gloves are placed on a wooden hand, and then brushed over with a soft paint brush steeped in

Curd soap	155 grains.
Milk	35 fluid ounces.

They are then dusted over with fine Venice talc, and rubbed with a bit of clean flannel. If this process does not leave them white enough, it is recommenced.
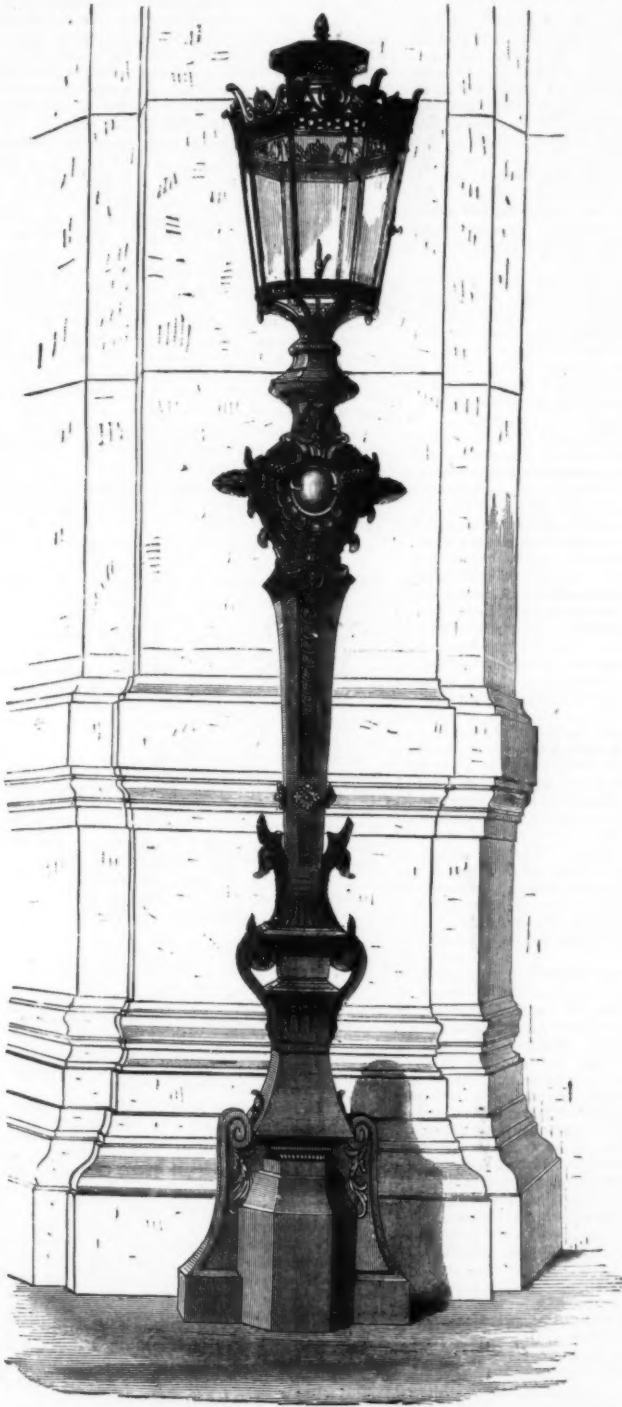
SUGGESTIONS IN ORNAMENTAL ART.—BRONZE CANDELABRA AT THE NEW OPERA HOUSE, PARIS.

Glycerine dissolves readily the coal-tar preparations, such as the aniline colors, alizarine, etc.

It is particularly important in tanning, and in the treatment of skins, contributing to the preservation of the natural weight, and preventing them from becoming brittle or turning moldy. In tanneries it has received the following application:—The hides, lightly tanned, are plunged for 24 hours into glycerine, which has been previously diluted with an equal weight of water, so as to mark about 15° Baumé, and are then dried.

Glycerine is not less important in weaving. By its use the sizing never acquires a bad smell, and the weaver may work with open windows and in dry weather without the slightest danger of his warp becoming brittle. Moreover, the addition of glycerine to the sizing prevents the warp from turning moldy or fermenting, and thus prevents the formation of spots. The following receipt has done good service:—11 lbs. dextrine, 26 lbs. glycerine, at 28° B., 2 lbs. 3 ozs. sulphate of alumina, and 26 quarts water.

As already mentioned, glycerine serves to dissolve the aniline dyes and various other colors. It serves also to preserve, for a long time, in a soft state the compositions of albumen, of casein, and the solutions of gum used for mordanting and finishing, because from its antiseptic nature it hinders these substances from becoming putrid.

Glycerine is generally chosen of from 26° to 28° B., free from acid or alkali, and consequently neither turning litmus paper red nor blue. Glycerine at 30° B. is rarely used.

Glycerine should be free from lime if it is to combine kindly with colors. To detect this impurity it is mixed with an equal measure of water, placed in a test glass, and a few drops of oxalate of ammonia are added. If lime is present, a white turbidity will appear.

The chief adulteration of glycerine is with solution of sugar.—Teinturier Pratique.

HOW TO CLEAN AND LACQUER BRASS.

BOIL it in a solution of potash and water, to remove old lacquer, grease, etc., then swill quickly through dipping aquafortis, well wash in water to remove acid, and then dry as quickly as possible by shaking well up in dry sawdust. The parts intended to be bright must be burnished with steel burnisher; afterwards lacquer with pale or deep gold lacquer, according to taste. The parts requiring bronzing (if they have been bronzed before), after having the old lacquer and grease removed as before, may be well polished with good

STRAW.

After cleaning as above and rinsing well in water, two baths are prepared:—1. A bath of soda at ¼° B. 2. A bath of nitrate of iron at the same strength.

The gloves are brushed first with No. 1, then dried and brushed with No. 2, and finally with water, and dried at a gentle heat. They are then finished with the following mixture:—

Yolk of egg	155 grains.
Glycerine	77 ozs.
Water	1½ pint.

When half dry they are rubbed with clean flannel.

For modes and grays they are cleaned with soap in the usual manner, and after they have been brushed with water they are brushed over with the following mixture at 104° F.:—

Logwood	45 grains.
Orchil	8½ ozs.
Water	1½ pint. Boil.

A second bath is prepared of 30 grains of nitrate of iron in 35 ozs. of water, and is applied with the brush to produce a gray tone.

For a red tone add to the bath 30 grains of alum. Dry and rub with flannel and farina.

BRIGHT BROWN.

After putting the gloves on the wooden form, and brushing with soap and water, and finally with pure water, they are brushed over with 75 grains of tannin, dissolved in 35 fluid ounces of water. Next dissolve—

Aniline brown.......................... 75 grains.
White glue .... 45 "

in 1½ pint of water. Heat to 99° F., and apply it to the gloves with a brush.

If a heavier shade is wanted, the gloves are brushed again with the solution of 15 to 45 grains of methyl violet, in 1¾ pint of water, at 99° F., and let dry.

They are finished with the same mixture of glycerine and yolk of egg as mentioned above.

For a redder shade, instead of aniline brown alone, a mixture of half aniline brown and half magenta may be taken.

CHOCOLATE.

The gloves are put on the form, and brushed three times with the clear solution of ⅗ oz. catechu in 1½ pint of water, and then three times with the solution of ⅗ oz. bichromate in 1½ pint of lukewarm water. If the shade is not deep enough, repeat the process, and use, if needful, also the decoction of ¼ oz. of lima-wood, boiled with 75 grains of alum, in 1¾ pint of water. This is applied with a brush till the shade is obtained, and the gloves are then dried. They are then finished with egg and glycerine, and rubbed off with starch.—*Teinturier Pratique.*

THE DAVY LAMP.

At a late meeting of the Manchester Geological Society, Mr. Joseph Dickinson, F.G.S. (Her Majesty's Inspector of Mines), the President of the Society, occupied the chair, and read a paper "On the Davy Lamp, and Blasting in Mines." He said: The Davy lamp is known to be safe only under certain circumstances. It may be put into an explosive or inflammable mixture, and if withdrawn quietly the gas flashes or burns inside the gauze, sometimes putting the light out and sometimes not, but without flame passing through the gauze. The standard mesh of the gauze is 784 apertures (28 by 28) to the square inch. With this the cooling property appears to be such as to prevent the ignition of gas externally until the gauze becomes red-hot, or unless there be some defect in the lamp or some easily firing or flaming substance on the gauze. I have on hundreds of occasions had to trust my life to this kind of lamp. The practice is to lift it up toward the roof. If held for a short time till it gets heated it apparently indicates better. Many prefer trying with a very small light, as the indication may then be seen best. Looking through blue glass is also now said to be an improvement. The usual indication is a blue cap on the flame, but the whiter it is the quicker it fires. If the cap begins to tail up or the flame to flutter, and there be time, it is best to lower the lamp without allowing it to fire, but always gently. When the top of the lamp touches the roof without showing gas, the practice in some districts, but which is reprobated in others, is to place the lamp sideways, in order to test the uppermost part, where fire-damp naturally lies. The gauze of the Davy as commonly used is about 5½ in. in length by 1½ in. in diameter, with a cap for the top. This, according to the experiments recorded (p. 39, vol. 17, North of England Institute of Engineers), admits of flame passing through, or of external ignition at a velocity of 11½ ft. per second or 690 ft. per minute. Should a person get into an explosive mixture where the lamp fills with flame and continues burning, notwithstanding that the wick be drawn down, and there is no escape, the special colliery rules of this district enjoin that he must smother it out. How that may best be done is left to his own discretion. If water were near he might probably dip it in, or if dust cover it, or put it into his woolen jacket. Under such circumstances there is some risk. In Scotland the Davy lamp is used by the firemen in trying places, but that used by the miners is called a gauze lamp. The principle of the two lamps is the same, the difference being that the gauze lamp is larger and gives better light. At a time like this, when the public mind has been excited by a very serious explosion, and when, as I am informed, the Coal Association are discussing the question of lighting and blasting in mines, it may be useful to review the regulations which are now in force. The rules under the Coal Mines Act are very strict, and the special rules of this district supply further conditions. The powder rule is very stringent. Powder may only be taken into a mine in canisters containing not more than 4 lbs. If fire-damp has been found in that part of the mine within the preceding three months the powder must be in cartridges, and the shots may also be fired under the supervision of a competent person appointed for the purpose. If the mine be very fiery, according to the test enjoined of showing indications of gas as it issues from the strata, notwithstanding adequate ventilation, shots may only be fired when the ordinary work-persons are out of that panel of the mine. And, lastly, it may not be used at all unless it is safe. Further than this it appears impossible to go unless by total prohibition. The condition of the use of open lights is shown by the explosions at Blantyre, with 200 lives lost, and 114 at Cymmer, to be unreliable. But to forbid the use altogether would be to sacrifice the advantages given to science.

CURIOUS FACTS ABOUT THE TELEPHONE.

By Wm. F. Chaening.

In the *Journal* of November 1, you write me to describe the conditions under which the telephonic concerts performed in New York, for the benefit of audiences in Saratoga, Troy, and Albany, were overheard in Providence. The circumstances were these. During five evenings in the latter part of August and first part of September, performers stationed in the Western Union building in New York sang or played into an Edison musical telephone, actuated by a powerful battery, and connected with one or other of the cities above named by a No. 8 gauge wire, with return through the ground.

In Providence, on the evening of the first of these concerts (August 28th), Henry W. Vaughan, State Assayer, and the writer were conversing through Bell telephones over a shunt made by grounding one of the "American District Telegraph" wires in two places, about a quarter of a mile apart, through suitable resistance coils. At about half past eight o'clock we were surprised by hearing singing on the line, at first faint, but afterward becoming distinct and clear. At the same moment apparently, Clarence Rathbone, talking with a friend through Bell telephones, over a private line in Albany, was interrupted by the same sounds. Afterward, during that and subsequent concert evenings, various airs were heard, sung by a tenor or soprano voice, or played on the cornet. The origin of these concerts remained a mystery for some time in Providence, and the lines were watched for music many evenings. The programmes heard proved to be precisely those of the Edison concerts performed in New York. the tenor singers being Signor Tagliapietro and D. W. McAneeny (baritone), and the soprano singer Madame Belle Cole.

The question how this music passed from the New York and Albany wire to a shunt of the "District" wire in Providence is of scientific importance. The Edison musical telephone consists of an instrument converting sound waves into galvanic waves at the transmitting station, and a different instrument reconverting galvanic into sound waves at the receiving station (using the word "wave" in its broadest sense). The battery used in sending the music from New York to Saratoga consisted of 125 cells (carbon bichromates, No. 13½), with from 1,000 to 3,000 ohms' resistance interposed between the battery and line connections in New York.

Mr. Geo. B. Prescott, to whom I am indebted for these figures, informs me also that the wire used in these concerts extended from the Western Union building, corner of Broadway and Dey streets, through Park Row, Chatham Square, the Bowery and Third avenue to 130th street, and thence via the Harlem Railroad to Albany. On the same poles with this Albany wire, for sixteen miles, are supported no less than four wires running to Providence, three of them being on the same cross-arm, and one of them being Boston wire No. 55 east, via Hartford and Providence; also for eight miles a fifth wire, Boston wire No 32 east, via New London and Providence. These wires, including the Albany wire, are understood all to have a common ground connection at New York, and to be strung at the usual distance apart, and with the ordinary insulation.

At the Providence end of the line, six New York and Boston wires, Nos. 55, 32, 2, 5, 27 and 28 east, run into the Western Union building, in company (on the same poles and brackets), for the last 975 feet, with an "American District" wire. This last runs especially near to wires 55 and 32, whose proximity to the Albany wire in New York has already been traced above. But here is a distinct feature. The "District" wire belongs to an exclusively air circuit of four and a half miles, having no ground connection. The New York and Albany and New York and Boston wires are or may be grounded at both ends. The "District" circuit referred to in Providence is geographically two circuits, but electrically one, both working through a single battery of fifteen cells. Mr. Vaughan and myself having "District" boxes, a quarter of a mile apart, on this circuit, made a shunt for telephonic communication by ground connection at each house, including several hundred ohms' resistance, so as not to impair the galvanic insulation of the line. The telephone talked through this perfectly, and the sounds of atmospheric electricity were heard in remarkable perfection.

It will be seen that the music from the Albany wire passed first to two or more parallel New York, Providence and Boston wires; second, from these to a parallel "District" wire in Providence; and third, through a shunt of that "District" circuit. before reaching the listeners there.

This transfer of electric motion from one wire to another may have taken place by induction, by leakage, or, in the first instance, in New York, by a crowded ground conductor. In the transfer in Providence from the New York and Boston to the "District" wire there was no common ground connection, and it is difficult to suppose that sufficient leakage took place on the three brackets and three poles, which were common to the New York and the local wire, to account for the transfer in Providence. The Bell telephone has also proved itself abundantly capable of picking up signals in an adjoining wire by induction alone. Without rejecting wholly, therefore, the other modes of transfer, I should ascribe to induction the principal part in the transfer of the concerts from wire to wire between New York and Providence.

What proportion, then, of the electrical music, set in motion in New York, could have reached the listeners on the shunt in Providence? Whether induction, leakage, or crowded ground was concerned, will any electrician say that the New York and Providence wires, situated as described, could have robbed the Albany wire of one-tenth or even one-hundredth of its electrical force or motion? When this one-tenth or one-hundredth reached Providence, will any electrician say that the wires from New York in the course of 975 feet could have given up to the parallel "District" wire one-tenth or one-hundredth of *their* electrical wave motion? Lastly, when the District circuit had secured this minute fraction of the original music-bearing electric waves, will any electrician say that the shunt, as described (containing 500 ohms' resistance, while the shunted quarter of a mile of District wire contained only 5 ohms' resistance), could have diverted one-tenth of the electric motion from the District circuit?

The music heard plainly in Providence did not therefore require or use one ten-thousandth, hardly one hundred-thousandth, of the electro-motive force originally imparted to the Albany wire.

EXTRAORDINARY SENSITIVENESS OF THE TELEPHONE.

This startling conclusion suggests first the wonderful delicacy of the Bell telephone, on which point I shall venture to enlarge ; and second, the as yet unimagined capacity of electricity to transport sound.

The Bell telephone is probably the most sensitive of electroscopes for galvanic, magneto-electric, and atmospheric or free electricity, and will be used extensively in science and the arts, in this capacity. In the French Academy, on the 6th of November, Mr. Breguet introduced the telephone as, of all known instruments, operating under the influence of the most feeble electrical currents. Prof. John Peirce of Providence, has ascertained the Bell telephone gives audible signals with considerably less than one hundred-thousandth part of the current of a single Leclanché cell. In testing resistances with a Wheatstone bridge the telephone is more sensitive than the galvanometer. In ascertaining the continuity of fine wire coils, it gives the readiest answers. For all the different forms of atmospheric electrical discharge— and they are constant and various—the telephone has a language of its own, and opens to research a new field in meteorology.

A Bell telephone in Providence has been found, under very favorable conditions, to overhear the speech of another Bell telephone on a parallel wire. But it will be noticed that the music and Morse-operating so noisily overhead on other wires are not products of the Bell telephone, but of powerful galvanic currents. The delicate magneto-electric current of the Bell telephone is not generally exposed to eaves-dropping, unless different sets of wires actually come in contact.

Prof. Peirce has observed that if one screw-cup of a Bell telephone is connected with a ground wire, in use at the same time for Morse-operating, the Morse signals will be heard in the telephone, although the other screw cup is disconnected and there is no circuit. Here the coils of the telephone seem to be momentarily charged by the passing signals, on the principle of a condenser. A still more striking illustration of the electroscopic delicacy of the telephone is this: Prof. E. W. Blake, of Brown University, talked with a friend for some distance along a railroad, using the two lines of rails for the telephonic circuit. At the same time he heard the operating on the telegraph wires overhead, caught by the rails, probably by induction.

The absence of insulation in this experiment recalls another curious observation. The Bell telephone works better in some states of the atmosphere than in others. A northeast wind appears specially favorable. When a storm is approaching the sounds are sometimes weak; but the talking is often loud and excellent in the midst of a storm, when insulation is most defective. I have just verified this by talking over a short line where the wire is without insulation, and its only support between two houses the trunk of a tree, just now sheeted with water from falling rain. This apparent indifference to insulation in a telephone which will overcome a resistance of eleven thousand ohms is not easily explained. This is only one of a multitude of paradoxes presented by the Bell telephone.

THE TELEPHONE OPERATED BY LIGHTNING.

The sound produced in the telephone by lightning, even when so distant that only the flash can be seen in the horizon and no thunder can be heard, is very characteristic, something like the quenching of a drop of melted metal in water, or the sound of a distant rocket. The most remarkable circumstance is that this sound is always heard just *before* the flash is seen—that is, there is a probable disturbance (inductive) of the electricity overhead, due to the distant concentration of electricity *preceding* the disruptive discharge. On Sunday, November 18, these sounds were heard and remarked upon in Providence the first time for several weeks. The papers on Monday morning explained it by the report of thunder storms in Massachusetts on the preceding day. Frequent sounds of electrical discharge similar to that of lightning, but much fainter, are almost always heard several hours before a thunder storm. This has just (Nov. 26) been exemplified in Providence.

SOUNDS PRODUCED BY THE AURORA.

The sounds produced in the Bell telephone by the auroral flashes or streamers were observed here by Prof. John Peirce in May or June.

THE EARTH'S MAGNETISM SPEAKS.

I will give one further illustration of the delicacy of the Bell telephone, this time in relation to magnetism. In June last Prof. E. W. Blake substituted for the magnet of the telephone a bar of soft iron free from magnetism. When this was held in the line of the dipping-needle, the telephone talked readily *by the earth's magnetism.* But when the telephone was swayed into a position at right angles with the line of the dipping-needle (in the same vertical plane) it was absolutely silent; and the voice increased or faded out in proportion as the telephone was directed toward or receded from the pole of the dipping-needle.

It remains only to speak of the quality of the concert music overheard in Providence. The rendering of the music was very perfect, but articulation was deficient or absent, both in the songs and in some sentences which are said to have been declaimed in New York for the amusement of the audiences in Saratoga and elsewhere. The papers of the day report that the words were undistinguishable in Saratoga. There is therefore no reason to suppose that the sounds lost anything in quality in the course of their indirect transmission to Providence.—*Journal of the Telegraph.*

THE ELECTRIC CANDLE.*

By Wm. Lucien Scaife.

Having been requested to make inquiries in regard to the new process of electric illumination, I was invited to be present during some experiments at the extensive laboratory of the "Syndicat d'études d'eclairage electrique," situated No. 61 Avenue de Villiers, Paris.

Accordingly, last Thursday evening, I went to the above-mentioned address, and on presenting my entrance card was admitted to the large frame building which the Electric Light Company or Syndicate has lately erected in order to study and improve the already famous discovery of M. Jablochkoff, the probable precursor of the "light of the future."

As this invention has been in some cases erroneously described, we take the liberty of repeating its main features.

The electric candles, as sold at present, consist of two cylinders of carbon about ⅓ths of an inch in diameter, kept parallel and at a fixed distance (about ½ inch) from each other by means of an insulating substance consisting of a mixture of kaolin and other materials added to improve the quality of the light. It is largely due to the latter that the original illuminating intensity of the candles, as stated in the accompanying circulars of the company, have been considerably increased.

These non-conducting and refractory substances are made into a paste and molded into slender parallelopipeds, whose long sides are slightly concave toward the union with the carbon cylinders, or *carbons,* as we shall call them. The latter are held together at the top by a thin and narrow strip of asbestos, and at the bottom they are set into brass tubes or sockets about three inches long—the distance of insertion being about one-half inch. The tubes are separated by an insulating substance—either glass or asbestos, or both—the latter serving to keep the sockets in place.

The electric candles are, from their nature, brittle, and a slight shock or fall being sufficient to break them. Moreover, as the carbons and kaolin are held together only in two points, the former have a tendency to separate from the latter, especially if shocked, when the ligature of asbestos has been burned—which takes place almost immediately after the candle is lighted. The candles of ordinary size are about 12 inches in length, including the brass sockets; the consumable portion is therefore about 9 inches long. It is probable that the difficulties just mentioned will prevent an increase of size, unless some other means of uniting the three parallel pieces is applied. The selling price of a candle varies from 15 to 25 cents, according to the diameter of the carbons. The candles burn from two to three hours, according to their size and the intensity of the current, which is admitted by the "candlestick"—a very simple combination of thumb screws and supports for the candles.

* *American Manufacturer.*

With these preliminary remarks I shall now give a brief account of the laboratory and experiments.

The main hall of the building or laboratory is about 60 feet long, 40 feet wide and 25 feet high. The walls and ceilings are white. From the latter were suspended three chandeliers, the central one having three "opalized" glass globes about 1½ feet in diameter—each surrounding an electric candle. It was raised and lowered by means of pulleys and windlass. The other two chandeliers were ordinary gas lusters, each with sixty bat-wing burners. The latter alone were lighted when I entered the hall, but they amply sufficed to illuminate it.

The room contained moreover a great variety of electrical and other apparatus which have served for the extensive researches made by the company. After a careful and experimental comparison of all the best existing sources of electrical currents, the company has found that the Alliance magneto-electric machine is best adapted for the production of the electric light. The latter has, however, two objectionable features, which are not, however, without remedy, viz., the cost ($1,200 to $1,400) and its bulkiness. The hall contained four of these Alliance machines, worked by a steam engine in an adjacent room, the transmission of motion taking place by means of a shaft, pulleys and belts.

Besides these there were also photometric apparatus and various other instruments of precision and measurement. The electric currents distributed in different parts of the hall were controlled by an assistant stationed on a raised platform. A single Alliance machine furnished the currents for all the experiments mentioned hereafter.

M. Jablochkoff, the inventor of the electric candle, M. Denayrouze, the director of the company, and several assistants were present, and all were very courteous and attentive to the visitors—about fifteen or twenty in number, and belonging to several nationalities.

M. Jablochkoff is a tall and well-built middle-aged gentleman, with blonde hair, beard and mustache. He is a Russian by birth, has an intelligent face, and speaks French with a foreign accent. In the course of the evening he described a simple and ingenious arrangement by which the light of an electric candle is kept constantly in the focus of a reflector, by producing total reflection with a prism. He also stated that considerable difficulty had been experienced in making photometric comparisons on account of the difficulty of eliminating the influence of heat when certain photometers are used. It seems that Mr. Crookes had brought his radiometer from London in order to test the light of the electric candles.

Toward nine o'clock the gas was suddenly turned off, and at almost the same instant six electric candles were lighted. Of these three were on the central chandelier, and the others placed on three pillars in different parts of the room. Although all these lights were surrounded by large "opalized" or "porcelainized" globes, yet the difference between the two illuminations was remarkable. These six candles gave a light much more intense and "whiter" than the 120 naked gas-jets. The eye experienced but little more fatigue in regarding the globes sifting the electric light, than it does in looking at the ground glass globes of single gas-burners.

The diffused electric light was not at all disagreeable or painful, but being brighter and clearer than the gaslight the change caused a slight sensation of fatigue at first, such as we notice in passing from a room illuminated with diffused light to the direct sunshine. It is probable that we should soon become accustomed to the electric light if properly diffused, especially if the walls of apartments were of a nature to absorb instead of reflecting the light, like the whitened walls and ceilings of the company's hall. Outside of the building, and near the entrance, were also two lighted globes, which even in the surrounding darkness were not very unpleasant to the eye. This remark is equally true of those in the "Place de l'Opera."

On one of the walls of the illuminated hall was a series of silk specimens of all colors and tints, some of the shades being very delicate. Near by was the notice: "The electric light does not alter colors." This statement seemed to be verified by the experiments. At any rate, the smallest differences of tints were easily distinguished.

The Electric Light Company claims that the candle gives a perfectly steady and invariable light. During the experiments, however, the electric candles burned with variable intensity from time to time, although much steadier than ordinary gas flames. For instance, before and after the globes were removed, the electric lights showed a tendency to swell and contract at short intervals, and three or four times during the evening they changed color (becoming purplish)—globules of melted kaolin falling at the same time from the candles. These are, however, minor considerations in the presence of the important fact that the production of the electric light has been brought to such a high degree of simplicity, and further experiments will doubtless not only remove these slight defects, but give to the candle other qualities.

After a time the gas was relighted, but notwithstanding its great brilliancy at first, its light now seemed quite feeble, and of a dirty yellow color, in the presence of the electric illumination.

The three candles of the central chandelier were next extinguished, and the globes removed from the other three. Although the difference was now less complete, yet the quantity of light seemed to be nearly as great as in the preceding case.

The changes of the flame became more evident, but only when the candles were regarded directly; that which I could do for several minutes in succession without too great a strain on the eyes; thus showing that the electric candle-light is much less concentrated than that of the ordinary electric lamp, whose arc can be supported by the naked eye for only a few seconds.

The voltaic arc of the candle cannot be recognized, being drowned by the incandescent kaolin. When the flame is seen through a colored glass, its size becomes much smaller than a candle flame, whereas to the naked eye it appears two or three times as large. The shadows produced by the candles, even when the globes were removed, were not striking, probably owing to the judicious arrangement of the luminous centers.

Finally, two electric candles, placed on a small plank or candlestick easily held in one hand, were lighted in the usual manner, viz., by laying bits of plumbago between the carbons and allowing the currents to pass. The arc appeared almost instantaneously. The electric light was not visibly affected by the position or motion of these candles, whether erect or inverted, blown or shaken, nor when carried on a run to a distance of a couple of hundred feet. This simple and easy manipulation of a light equal in intensity to 100 Carcel burners, or 700 stearine candles, will suggest various important applications for naval and other purposes.

I shall not dwell on the different kinds of electric candlesticks, nor on the methods of lighting several candles in succession, but would refer for these and other interesting points to the accompanying explanatory documents and price list, which will be furnished, together with estimates, to any one applying to the company, whose address is given above.

M. Jablochkoff calculates that in the most unfavorable cases his electrical illumination costs from ¼ to ⅛ the price of gas for equal quantities of light—each candle giving an intensity of about 50 Carcel burners; he states, moreover, that in works possessing the necessary motive power, this relative cost may be reduced to one-tenth and even less. In these estimates the first cost of electrical apparatus is supposed to be balanced by that of gas fixtures—although the latter is probably greater in most cases than the former.

The electric light is most economical when but few and powerful luminous centers are used. On account of its intensity, it cannot be employed with advantage for small apartments, and hence there is no danger of its replacing gas in ordinary house illumination, until some means have been discovered for dividing it to a still greater extent than even M. Jablochkoff has done. However, it is probable that the electric candle will find no favor for street illumination, until it has been made to burn longer than at present without the devices actually used for the purpose, and until the process of lighting has been still further simplified.

The invention of M. Jablochkoff may however be advantageously employed in large halls and stores, railway stations, etc. Here in Paris it is at present used in the well-known "Magasins du Louvre," in one or more extensive manufactories, and in the large square in front of the Grand Opera.

Finally, before leaving the interesting laboratory of the Electric Light Company, I witnessed several experiments which showed conclusively that the electric candle does not radiate any more heat than an ordinary tallow dip. This is due to the fact that the intense heat of the voltaic arc is used for volatilizing the refractory kaolin, and thus for increasing the size and intensity of the flame.

A REMEDY FOR INDUCTION DISTURBANCES IN TELEPHONES.

THE induction disturbance from neighboring wires at work, which Mr. Preece likened to the pattering of rain, and which has since been compared to the less poetical phenomenon of fat crackling in a frying pan, has been successfully overcome by a plan of Dr. Muirhead's. This consists in coating the line wire with a thin insulator, and winding a thin conductor, such as tinfoil or copper strip, round the outside of the insulator. This strip is connected to earth, and acts as an induction screen for the line wire; but it need not be so closely applied as to cause any serious retardation in the line currents.—*The Telegraphic Journal.*

TRANSMISSION OF THE PRESIDENT'S MESSAGE.

No special effort was made to accomplish the transmission of the annual message of the President from Washington to New York this year with unusual speed, but very good time was made notwithstanding. On the Western Union lines it was sent on 10 wires, 11,369 words being transmitted, time being 42½ minutes. The copy was delivered in good shape, properly capitalized and punctuated. On the Atlantic and Pacific Company's lines 7,269 words were transmitted. Two Morse wires were used, on which about half the total was transmitted, the other half being perforated and transmitted automatically upon a third wire, which was also used for signaling and for general business. Copies were dropped at Baltimore and Philadelphia. The time occupied was one hour and thirty-five minutes, and the copy was delivered in good shape and satisfactorily to the press.

THE STATE OF THE GASTRIC JUICE IN TYPHOID FEVER.

THE *Berliner Klinische Wochenschrift* gives the history of a case in Professor Kussmaul's clinique at Strassburg, which tends to show that during the dyspeptic stage in typhoid fever the gastric juice contains no free hydrochloric acid, though pepsine is abundantly present, as has been already proved by Hoppe-Seyler and Parry. If the juice shows acid reaction, this is due to either acetic or lactic acid, but it may, as Kussmaul's case shows, become alkaline from the presence of bile or pancreatic juice after retching or vomiting. The absence of hydrochloric acid lasted as long as the fever and up to the eighth day after its disappearance, proving the old maxim by which typhoid reconvalescents are forbidden solid food for that period. As Professor Kussmaul's assistant points out, the great advantage of giving hydrochloric acid in fevers is confirmed by this case. He also mentions the experiments made on dogs by Manasseïn in Hoppe-Seyler's laboratory, in which, by injecting putrid liquids into their veins and creating fever, the quantity of free hydrochloric acid in proportion to the pepsine became diminished. Some old notes, made of similar experiments in Hoppe's laboratory at Berlin nearly twenty years ago, confirm this as far as the reaction of acidity by test paper goes. The gastric juice of dogs is normally always strongly acid, and this acidity is mainly due to a normally high proportion of hydrochloric acid. As Rabuteau stated only a few years ago, in the *Comptes rendus*, it amounts, on an average, to 4 per mille, or 0·4 per cent.

PHYSIOLOGY.

THE REGENERATION OF VISION-PURPLE OUTSIDE THE BODY. —The retina of the frog, after it is removed from the eyeball, deprived of every vestige of black pigment, and bleached in direct sunlight, still has power to regain its original color, though not in its original intensity. In a few hours, if kept in the dark, it will turn, first yellow, then buff-colored, and, lastly, rose-red. This succession of changes may be repeated several times over in one and the same specimen. When the retina has been bleached in the living animal before its removal from the eye-ball it is no longer able to resume its original red hue. Solutions of retina-purple in purified bile, free from ether, are also capable of regaining their color after they have been robbed of it by exposure to light. Similar solutions of the retinal epithelium (apart from the rods), freed by mechanical means from suspended particles of black pigment, likewise exhibit the above property. In the dark they are rose-colored; they are bleached by light; they regain their rosy hue once more when the light is shut off from them. This power of regeneration is most strikingly exhibited by mixed solutions of the rods and retinal epithelium. —Ewald and Kühne, *Centralblatt f. d. med. Wiss.*

THE GENESIS OF RED CORPUSCLES.—M. G. Pouchet has brought a communication on this subject before the Société de Biologie (*Gazette Méd. de Paris*). He believes that the most direct method of attacking the question to consist in an examination of the blood and the intimate structure of the spleen in the Selachian fishes. By following this plan he arrived at the conclusion that in *Scillium catula*, and probably in most vertebrates, the blood invariably contains corpuscular elements which cannot be distinguished from those which make up the splenic parenchyma. These elements are smaller than ordinary leucocytes; they exhibit a peculiar pearly luster by transmitted light; their surface presents smooth protrusions of sarcodic matter; they contain a voluminous nucleus which turns slightly brown under the influence of osmic acid. These elements pass, through a series of intermediate stages, into fully formed red corpuscles; they increase in size, lose their sarcodic properties to assume a regular figure, their nuclei shrink, and haemoglobin makes its appearance in their interior.—*Academy.*

VARIATIONS OF BLOOD-PRESSURE IN THE AORTIC SYSTEM. —The peculiar undulations, synchronous with the respiratory movements, which are exhibited by kymographic tracings of arterial blood-pressure have been hitherto ascribed partly to variations of intra-thoracic pressure, partly to rhythmic stimulation of the cardio-inhibitory and vaso-motor centers in the medulla oblongata. These causes, however, are not really adequate to explain all the observed phenomena. Some of them undoubtedly operate under one set of conditions, some under another; what is wanted, however, is a general principle capable of accounting, either alone or in connection with other accessory factors, for the respiratory variations of blood-pressure under all the different conditions to which the functions of breathing and of circulation can be experimentally subjected—in artificial as in natural respiration; when the thorax has been laid open and when it is closed; when the cardiac nerves have been cut and when they are intact, etc. A general principle of this kind Funke and Latschenberger believe themselves to have discovered (*Pflüger's Archiv*, xv., 8 and 9) in the varying flow of blood through the pulmonary capillaries, determined by the varying expansion of the lungs. Every inspiratory expansion of these organs, whether it be attended by a plus or minus degree of intrathoracic pressure, must, by stretching the walls of the air cells, lengthen and narrow the individual capillaries and thus diminish their collective capacity. Conversely, the expiratory collapse of the air cells must widen the capillaries and augment their capacity. These changes must influence not merely the flow of blood between the two sides of the heart, but the tension in the aorta likewise. The primary effect of inspiration will be to raise the latter by squeezing the blood out of the lungs in the direction of least resistance—into the left auricle—and thus feeding the left ventricle with more blood. Its secondary effect will be to lower arterial tension by checking the current of blood through the lungs. Expiration will primarily lower arterial tension by lessening the supply of blood to the left auricle; its secondary effect will be to raise it by facilitating the flow through the pulmonary capillaries. These a priori considerations were put to the test of experiment, and a long account of the investigation is given in the original memoir. Its results confirmed the anticipations of the authors in every particular. They conclude that the essential cause of the respiratory variations of arterial pressure is always to be sought in the varying capacity of the pulmonary capillaries due to the alternate expansion and contraction of the lungs. In artificial as in natural breathing, the inspiratory rise of tension is owing to the blood being squeezed out of the lungs into the left heart; the expiratory fall, to the retention of blood in the dilated pulmonary capillaries. In natural breathing, the respiratory variations of intrathoracic pressure of course contribute—but only as accessory elements—to the general result; the same may be said of variations in the rate of the heart's action.

ON TISSUE-METABOLISM IN BLOODLESS FROGS.—It is well known that a healthy and vigorous frog will live for days after the whole of its blood has been withdrawn from the vessels and replaced by a 0·75 per cent. solution of common salt. Oertmann has recently availed himself of this fact in order to obtain a direct answer to the question whether oxidation takes place in the blood, in the tissues, or in both together (*Pflüger's Archiv*). He compares the amount of oxygen consumed and the amount of carbonic acid given off by normal frogs with the corresponding values in the case of "salt" frogs. A series of comparative experiments, carried out with all needful precautions against error, showed conclusively that in the frog the processes of oxidation are in no way affected by complete removal of the blood, the tissue-metabolism of the bloodless frog being maintained at the normal level. From this it follows that oxidation must go on in the tissues, not in the blood. Of course the salt water cannot take the place of the blood for any length of time; the "salt" frogs only lived for a period varying from one to three days; but during the first ten or twenty hours of this period the energy of their metabolic processes was not in any degree reduced.

ON THE BEHAVIOR OF GLYCOGEN WHEN INTRODUCED INTO THE CIRCULATION.—Existing statements on this subject are in conflict with one another. Pavy, for instance, found the injection of glycogen into the vessels of a living animal to be followed by the appearance of sugar in its blood, and—when the quantity injected was considerable—in its urine likewise. Schiff altogether failed to discover sugar either in the blood or in the urine. Böhm and Hoffmann (*Archiv für exper. Pathol. und Pharmakologie*, vii., 6) have investigated the matter afresh. They find that if from three to ten grammes of pure glycogen be introduced into the jugular vein of a cat, the urine is more copiously secreted, and assumes a reddish tinge owing to the presence of dissolved haemoglobin. It contains no red disks. Glycogen, therefore, resembles a glycerine and many other substances in exerting a solvent action on the colored elements of the blood. On examining the urine by the polariscope, and testing it with Fehling's solution, they found, to their surprise, that the indications furnished by the two methods did not agree, the former indicating the presence of from five to ten times as much sugar as the latter. Further inquiry showed that only a part of the glycogen is transformed into a compound able to reduce the copper solution—probably glucose; another part being converted into a carbo-hydrate which agrees in all its properties with the achroodextrin of Brücke and Nasse.

HOW THE AIR-PASSAGES ARE EXPLORED.

By F. SEEGER, M. D.

ONLY a few years ago physicians were absolutely in the dark when applied to by those afflicted with disease in the throat; and that where then all was darkness, there now is clear light, thanks to the zeal and scientific devotion of Prof. Türck, of the University of Vienna, who, in 1857, was the first to successfully use the laryngoscope as a means of determining the nature of a disease in the throat of a patient then in the wards of the General Hospital of Vienna, of which latter Türck was physician-in-chief.

Fig. 1 depicts the laryngoscope, or laryngeal mirror. At the left end we see the mirror, which is set in a silver frame and back; this in turn is attached to a metal stem, and the stem itself is set in a wooden handle, which latter is merely a matter of convenience by which the physician is enabled to handle it with more ease and facility. The mirror is made of various sizes, from that of a cent to that of a silver half dollar, and is so attached to the stem as to describe an angle of 120° to 125°.

Prior to the discovery of the laryngoscope, the great obstacle to the diagnosis and comprehension of disease of larynx lay in the fact that this organ was so placed as to be at an almost direct angle to the line of vision. If we look into the mouth of another person, we see the back of the mouth; but if we wish to see the larynx, or organ of tone and voice, we are unable to do it, even though its position is just back of and below the root of the tongue. And, even though we press down the tongue, we derive no aid. Nor are we enlightened by symptoms of pain or discomfort in the throat, for these are not only insufficient, but may be absolutely deceptive. A patient may complain of aches and pains, and may imagine them in the larynx, and all the while the organ may be in a perfectly sound state; and, on the other hand, again, grave forms of throat disease may exist, and with so little of actual pain as to cause the victim hardly any uneasiness. The revolution in this department of the medical art may perhaps be best illustrated when I refer to the fact that ere the introduction of the laryngeal mirror, barely twenty years ago, there were but two or three forms of laryngeal disease recognized or treated of in the text-books on the practice of medicine. At the present time, the study of the numerous and varied diseases of this wonderful little organ, the larynx, has made such strides that laryngology has, like ophthalmology, otology, and gynæcology, demanded and received recognition as a separate and distinct department of medical practice, and has its special practitioners in almost every city of size and population. Whereas, formerly, the two or three recognized forms of throat disease were dismissed in a scant dozen of pages in the medical text-works, we now have exhaustive and elaborate treatises in all of the great languages of the civilized world.

The rhinoscopic mirror, or rhinoscope, is practically but a laryngeal mirror of a smaller size. The stem and handle are the same, and attached in the same manner, at about the same angle, but there is the difference of a much smaller size as compared to the laryngoscope, the mirror being usually about the size of a silver three-cent piece. Its use is to enable us to see the back or inner parts of the nose (posterior nares), and the upper part of the pharynx or vault of the back of the mouth. Its discovery, which occurred soon after that of the laryngoscope, is due to the patience and genius of Czermak, and was a direct result of the discovery of the laryngeal mirror. The parts which it enables us to see are hidden behind and above the palate, and the office of the rhinoscopic mirror is simply to so reflect the light as to illuminate these parts, and in turn enable their image to become visible in the mirror. In the first instance the little mirror is placed at the back of the opened mouth of the patient.

At the same time a powerful and clear light from an illuminating apparatus is directed into the patient's mouth, and the rays striking upon the mirror are so reflected upward and forward as to illuminate the parts we seek to examine, and these are then, as just remarked, made visible in the mirror. And in this principle lies the entire secret of the art of making a laryngoscopic or rhinoscopic examination. It is simply a dexterous management of mirrors to secure proper reflection of light, and the consequent illumination and examination of hidden recesses.

The rhinoscope also enables us to examine the nasal or pharyngeal orifices of the Eustachian tubes. These latter are passages leading from the inner side of the drum of the ear, and opening, as already indicated, at a point situated in the posterior nasal parts. It is not the province of this article to enter into minute or precise detail, and therefore we shall merely add that these tubes bear a very important relation to the faculty of hearing. If the nasal orifices of these tubes become swollen by disease or choked with diseased mucus, greater or less impairment of the hearing-power results. Consequently, the rhinoscope has rendered no small service to us for determining causes of deafness, and of curing them, which formerly were but guessed at or remained unknown.
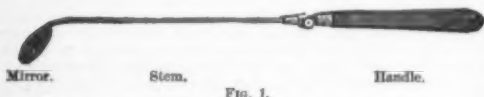

| Mirror. | Stem. | Handle. |

FIG. 1.

But to make the laryngeal and rhinal mirrors available, the artificial illumination of these parts is necessary. To depend upon the sun's rays, as was the case with the original experiments, was too uncertain. Czermak, as we have seen, substituted artificial light, and thus enabled an examination to be made at any hour of the day or night. Tobold, of Berlin, after a time, brought forward an apparatus which is depicted in the following cut, and which embodied the most perfect apparatus of the time. The cut also shows us the position of the patient and of the examiner.

As introduced by him, it consisted of a common study-lamp: a is a brass tube, or light condenser, in which are convex lenses, c, d, g. The lenses c and d, it will be observed, are close together, while the third, g, is at the distal extremity of this brass tube. At f this brass tube can be unscrewed, thus enabling the cleaning of the lenses. The lens g can also be removed at h. m is a brass arm having three joints, and fastened to the lamp. At the extremity of this arm is a perforated knob, s, through which the handle of the reflector, i, is passed, and which is fastened by a screw. At o is a single charnière joint, which permits of the forward or backward motion of the reflector—the illuminating agent being oil. By substituting gas burned through an Argand burner, and fed from any ordinary burner, the

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apparatus has been made more available, and better light obtained.

It is not necessary to dwell upon the changes. Suffice it that by these the apparatus has been made much more ready and simple in management, and less liable to derangement of focus at important moments when a steady light is needed for intra-laryngeal operations. It is here that we should call a brief attention to the vast strides which, under the influence of the laryngoscope, have been effected in the operative procedures upon this organ. All of these are now made by means of instruments curved at a direct angle to the line of vision, and in none of these operations does the operator directly see the objective point. His operations are all made under the guidance of the image which he sees reflected in the laryngeal mirror, and are comparatively bloodless and accompanied by little or no pain.

A laryngoscopic examination is made as follows: In the second cut we see the positions of the examiner and patient. The patient opens his mouth as widely as possible, and at the same time protrudes his tongue. The examiner then with a small napkin takes the protruded tongue
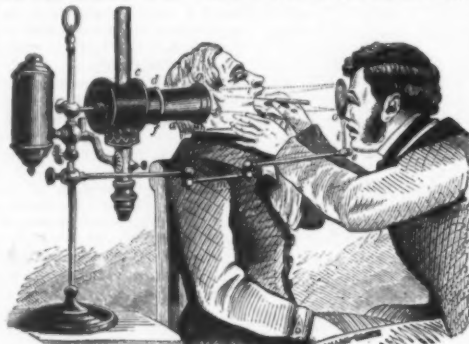

FIG. 2.

THE RHINOSCOPE.

between his tongue and forefinger, thus gently steadying it and preventing its slipping back into the mouth. The object in thus protruding the tongue is to enlarge the cavity of the mouth as much as possible. The laryngeal mirror is next warmed, either over the chimney of the illuminator or in some warm water, so at to prevent its becoming obscured or dimmed by the breath. It is then quickly and dexterously carried to the back of the mouth. A bungling manner of doing this, by causing great irritation of sensitive parts of the mouth, causes gagging and even vomiting, and, this once excited, all further examination is either very difficult or impossible at this sitting. It is not to be taken for granted, however, that examinations can readily be made in all cases, nor even in the larger majority of the patients. With many there is no trouble, but there are also quite a number of patients whose throats are so irritable from disease as to prevent the introduction of the laryngoscope. In other cases the patient's tongue has an almost irresistible tendency to keep rising up toward the roof of the mouth and thus obstruct the view. Enlargement of the tonsils according to the degree of their enlargement makes an examination either very difficult, or else, if so much enlarged that they meet and almost close up the throat, makes it impossible until the enlargement has been reduced. For the overcoming of mere irritability of the throat or fauces when this pertains to a degree sufficient to be troublesome, various means have been resorted to, to produce local anæsthesia of the fauces. A piece of ice held in the mouth, the water being swallowed, is one plan. Another is to drop twenty drops of chloroform on a handkerchief and let the patient inhale it for a minute. With most cases of irritable throat this is quite sufficient, and without at all rendering the patient drowsy or uncomfortable. Bromide of potash has been used, but has not given satisfaction practically.

The examiner, having avoided touching the back of the tongue and of the pharynx with the mirror, carries it, as already said, to the back of the mouth to an oblique position below the soft palate and with the uvula or "drop" of the palate at its back. The rays of light from the illuminating apparatus, striking the laryngeal mirror, are then reflected in a downward direction and light up the parts (the larynx) below. These, being illuminated, are in return depicted upon the laryngeal mirror above. The process may be compared to that of the management of toilet-mirrors to enable us to see the back of the head. In the latter proceeding it is not the back of the head which we see, but, as it is hardly necessary to add, merely its reflection in the mirror.

And at this point we should remark that, while the laryngeal examination to one versed in the art is comparatively easy, the rhinoscopic examination, on the other hand, is a very difficult matter, and calls into play no small amount of skill and ingenuity. The reasons for this are mainly because of the unruliness of most palates, which have a tendency to bob up and down in a very provoking manner. We shall not dwell further upon this point, but briefly add a few remarks as to what this instrument has done for us. Where we can apply it we are no longer in the dark as to whether a case of disease is that of a chronic catarrh, nasal tumor, simple inflammation, swelling or ulceration. In our climate, in which diseases of the nasal cavities, and particularly catarrh, are so prevalent that it has been estimated that 10,000,000 of our people have the disease called catarrh to a greater or less degree, every advance by which we are enabled the more successfully to combat these complaints is of general interest and importance. How potent our climate is in causing catarrh is illustrated in the case of Charles Dickens, who contracted it so rapidly and severely as to necessitate his abandoning many engagements and compel his flight from this country. Interesting is the fact, which Darwin records in his "Descent of Man," that the Cebus azaræ, a species of Paraguayan monkey, is liable to catarrh with all of the symptoms found in his more human relatives, and which, when often recurrent, leads in them to consumption.

The higher animals, like man, are endowed with an organ of voice and sound, but man alone has the supreme gift and faculty of expressing the ideas and thoughts which his intellectual endowments and powers give rise to, or, plainly speaking, he alone has a articulate language equal to the expression of most of his feelings and sentiments. How

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wonderful, then, it becomes to us when we study the little organ which has the great task of placing man in direct communication with his fellow beings! And how wonderfully this little organ modulates its tone in accordance with the varying degrees of emotion and earnestness! And when we consider that each voice has its own peculiarities and characteristics which distinguish it from all others, our interest deepens. And yet there is little or in fact no difference in the mechanism of the various kinds of voice, the variations in pitch being due chiefly to the greater length of the vocal cords in the low-pitched voices and to their shortness in the high voices. Tone, whether in speech or song, is simply a result of the action of a volume of air in a quantity which is regulated by the will of the speaker or singer, which, coming up from the lungs through the windpipe, passes up through the larynx, where it causes the elastic vocal cords to be put upon the stretch to a greater or less degree according as the intended note is high or low, to vibrate, and thus is produced the tone which upon its entrance into the pharyngeal cavity and mouth becomes articulated, and the sound of which is variously and essentially modified according to the varying peculiarities of structure and formation of the larynx, pharynx, and mouth. It is also changed or modulated according as the various parts of the mouth, tongue, palate, teeth, and lips assume different positions. Cultivation of the voice also impresses its stamp. The tone-waves, as they rush out of the open mouth, communicate their vibrations to the air, which conducts the sound onward until it reaches our ears, provided we are within the reach of these atmospheric vibrations. The difference between a cultivated voice or note is soon detected in the purity and regularity with which its sounds reach us as compared to the harsh, irregular, discordant waves impelled by one not so cultivated. Johannes Müller places the extreme range of the human voice at four octaves, but it is quite seldom that the range exceeds two and a half octaves. In some phenomenal voices, like those of the gifted Parepa-Rosa, Peschka-Leutner, Mara, Farinelli, and other great singers, we meet with astounding range and power. Parepa-Rosa had a voice ranging full three octaves, from sol₂ to sol₃; and Flint, the learned and indefatigable physiologist, tells that at the World's Musical Festival at Boston, in 1869, she gave the most astounding exhibitions of the wonders which this little organ, the larynx, is capable of. In some of the solos by Madame Rosa, accompanied by a chorus of 12,000, with an orchestra of more than a thousand, and largely composed of brass instruments, Prof. Flint distinctly heard the pure and just notes of this remarkable soprano, standing alone, as it were, against the entire choral and instrumental force; and this in an immense building containing an audience of 40,000 persons! Mara's voice had compass, with equal fullness of tone, of three octaves, and she possessed such power of musical utterance that she imitated the most difficult passages of the violin and flute with perfect facility. Farinelli on one occasion competed with a trumpeter, who accompanied him in an aria. After both had several times dwelt on notes in which each sought to excel the other, they prolonged a note with a double trill in thirds, which they continued until both seemed exhausted. At last the trumpeter gave up, entirely out of breath, while Farinelli, without taking breath, prolonged the note with renewed volume of sound, trilling and ending finally with the most difficult roulades.

But these wonderful displays of the power of the larynx must not be ascribed entirely to the intensity of the tone, but are in no small measure due to the absolute mathematical equality of the sonorous vibrations and the comparative absence of discordant waves. By the degree of tension of vocal cords which is required for the pitch of a prescribed tone, and which, as we have seen, is greater in the higher and less in the lower notes, the muscles of the larynx really become the determining forces of the ability to sing, and a great deal depends upon securing for them the necessary practice, as for instance for the execution of rapid successions of tones. And herein lies the difference in the voices of singers, the purity of the tone depending upon the accuracy with which they put the vocal cords upon the stretch, while in those whose tones are impure and faulty, the difficulty lies in their inability to give the requisite tension, and of course the muscles take part in the shortcoming. A correct idea of the sound, height, and depth of the tone which the singer intends to communicate, enables him to strike the correct tension as by intuition, and carries him along its continuance and through its purity of modulation until it has ceased.—Popular Science Monthly.

NEAR-SIGHTEDNESS.

Is the Human Eye Changing its Form and Becoming Near-Sighted Under the Influence of Modern Education?—At the recent annual meeting of the Medical Society of New York County, Dr. E. G. Loring, in his valuable paper, answered the above question in a very satisfactory manner, as far as his observation and experience went. He said that hereditary influence was an important element in the production of myopia, and, although statistics did not strongly indorse that view, he still held that legendary information should receive much credence. In regard to the influence of modern education, it was found that a larger proportion of those living in cities were near-sighted than those in country districts; and, moreover, in those cities where intellectual pursuits were greatest, the largest number of myopes were found. In savage nations near-sightedness was very infrequent, and it would seem, in some respects, that it was a result of education. While the intellectual classes in Germany showed a large proportion of myopia, it was not so found in those artisans who used their eyes on fine objects, as watch-makers and wood-engravers. In England, where there has always been great intellectual activity, by no means as large a ratio of near-sightedness had been detected as in Germany, and it became necessary to seek for other factors to explain the prevalence of myopia. Impaired nourishment, imperfect ventilation, together with a sedentary life, had a marked tendency in producing laxity of the tissues in general, including of necessity the coats of the eye balls; and, with the tension which resulted from close application of the sight, there was a great probability of lengthening of the eye, or myopia, resulting. In New York the German children were found more often near-sighted than those of other nationalities. Dr. Loring said that undoubtedly myopia was hereditary, but that in all probability it could under certain circumstances be developed; but he did not believe that of necessity it must increase in a nation engaged in literary pursuits. In the United States the normal eye predominated, and he thought it was due to the fact that the young were more in the habit of indulging in out-door sports than in Germany. The same was true of England. From a careful analysis of the myopic cases, it was found that between the ages of ten and fifteen the majority developed; or, in other

words, at that time the tissues of the globe were most readily affected by strain of the muscles of the eye. It could be easily understood, under such a hypothesis, that the industrial classes were so little liable to near-sightedness, for they seldom reached the practice of the more intricate branches of their trade before their eighteenth year. In conclusion, Dr. Loring was of the opinion that, under proper precautions, the normal eye could be continued indefinitely. If children were not allowed to apply themselves too closely to their studies between their eighth and sixteenth years, and were, moreover, allowed the proper amount of out-door exercise, not much danger need be dreaded. It was important also to have the schools properly ventilated, and other hygienic conditions made as perfect as possible.—*N. Y. Medical Journal.*

DIPSOMANIA.

DR. BODINGTON very well urges in a late address, "The confusion between drunkenness as a disease, and drunkenness as a vice, must be cleared up. For my part, I look upon all habitual drunkenness as a disease, and I would boldly call it all dipsomania. It is in its character as a disease that we physicians are entitled to deal with it. I would sink the notion of its being a mere vicious propensity. When fully developed there are not two kinds of habitual drunkenness. The cases are, one and all, cases of dipsomania, of irresistible, uncontrollable, morbid impulse to drink stimulants."—*Medical and Surgical Reporter.*

DETECTION OF BISMUTH.

By W. M. HUTCHINGS.

THE mixture of equal parts of potassium iodide and sulphur recommended by Von Kobell for this excellent test has the great disadvantage of being very deliquescent; even if kept in closely-stoppered bottles it sooner or later becomes pasty, and indeed almost liquid, if the bottles are often open for use. As it is a great advantage to be able to have such mixtures ready for use, and, where possible, to keep them in little wooden boxes in the portable blowpipe apparatus, I have tried replacing the potassium iodide by cuprous iodide, and have been glad to find that, in addition to the advantage of being non-deliquescent, the mixture so made is in other respects superior for use with the test.

Von Kobell's mixture has another disadvantage, viz., that it itself yields a copious *white* sublimate, the brilliant red sublimate obtained when it is used with a substance containing a good deal of bismuth being caused by the mixture of this white with the dark brownish red given by bismuth iodide alone. When very little bismuth is present and a good deal of the mixture is used, the white frequently overpowers the red almost completely, and when other metals are present which also give white or light-colored sublimates it greatly assists in concealing the bismuth color. This disadvantage is also got rid of by using cuprous iodide and sulphur.

The precipitated cuprous iodide is washed free from all trace of potassium salts, dried perfectly, and then ground up to an intimate mixture with an equal volume, or rather more, of flowers of sulphur. This proportion is the best; when less sulphur is used there is more or less white sublimate of cuprous iodide obtained, and also the formation of bismuth iodide is not as copious. For testing pyritous or other sulphide substances, less sulphur, or even none at all, would be required; but it is best to have a mixture which is equally applicable to *all* bismuth combinations. This mixture can be kept rammed tight into little wooden boxes, and is always ready for use. On aluminium plate I find it decidedly more delicate as a reagent than the potassium iodide mixture, using in each case 2 volumes of reagent to 1 volume of the powdered substance to be tested, intimately mixing to a paste and heating gently on a charcoal slip.

The merest trace of the dark brownish red bismuth iodide is very conspicuous on the clean aluminium. The plate should be made pretty hot by blowing the flame upon it some distance above the ledge before commencing to heat the test mixture, in order to prevent the settling of any sublimate of *iodine*, or any condensation of moisture, -which latter destroys the red bismuth sublimate. This precaution is particularly necessary when very little bismuth is present.

On ordinary charcoal or blackened porcelain support the dark-colored bismuth iodide is not nearly so conspicuous as on aluminium, and does not show as well as the brighter red obtained by using potassium iodide. But a few tests with a substance containing very little bismuth will convince anybody that aluminium plate, with the cuprous iodide mixture, is very much preferable to charcoal and potassium iodide; and I do not think that any one who has once used aluminium for blowpipe sublimates will ever again use charcoal or porcelain.

Substances containing mercury, when treated with the iodide mixture on aluminium plate, give a sublimate of mercuric iodide, which is partly red and partly yellow, the relative quantities of the two colors varying much in sublimates from the same substance. The red is much lighter and brighter than that obtained from bismuth with the cuprous iodide mixture. It might possibly be taken for the bismuth sublimate mixed with that of lead; but as the number of minerals containing mercury is so limited, and the presence of that metal is so easily proved by other tests, no mistake is likely to arise from this cause.

The value of this test of Von Kobell's is very great; it deserves to rank as one of the best—in some cases the best—test for bismuth. As little as 0·2 or 0·1 per cent. can be safely detected by it in many cases, and with great rapidity. In pyritous ores, which fuse to a regulus or in smelted regulus, a considerable amount of bismuth might be present and not be detected by the ordinary sublimate of bismuth oxide, which is frequently very difficult to obtain from such combinations. But a fraction of a per cent. can be found by this test without resorting to the wet way.

Substances containing lead give a copious light yellow sublimate when heated with the iodide and sulphur mixture, and when lead is present beyond certain limits this yellow overpowers the bismuth reaction. According to Cornwall (*Chemical News*, vol. xxvi., p. 150), when lead oxide was mixed with 5 per cent. bismuth oxide and tested on charcoal by Von Kobell's mixture, the bismuth could only just be detected, and not with distinctness. But I find that when lead oxide containing only 1 per cent. bismuth oxide is tested with the cuprous iodide mixture on aluminium plate a very fine brownish red sublimate is always obtained by heating very gently and observing after a few seconds. Later on the yellow covers this up; but the bismuth iodide always comes off first, and can be seen if observed in time. In all cases sublimates must be allowed to get quite cold before

judging them; lead iodide is reddish when hot, but pure light yellow cold.

Cornwall's tests in open glass tubes (*Chemical News*, vol. xxvi., p. 150), which will detect bismuth when present in such small quantity with lead and antimony that the above method fails, can be better applied with the cuprous iodide mixture than with potassium iodide, and so much sulphur as he recommends (5 volumes) does not require to be added.

These mixtures are also very useful for detecting lead in cases where the ordinary sublimate of the oxide cannot be obtained.—*Chemical News.*

SPONTANEOUS FERMENTATION.

By MM. PAUL CAZENEUVE and CHARLES LIVON.

WHEN the urine of animals is exposed to the air the urea becomes hydrated, and is resolved into carbonate of ammonia, while vibriones make their appearance in the liquid. These facts meet with various interpretations Müller, Pasteur, and Van Tieghem ascribe the hydration of the urea to the action of a special Torulacea. Pasteur and Joubert consider that this action of the Torulacea is due more directly to the secretion of a soluble ferment, a sort of diastase. Fremy considers that a "hemi-organic" substance, present in all animal and vegetable liquids, is the immediate cause of the transformation of the urea. M. Béchamp finds in all animal humors molecular granulations, to which he ascribes life, and lets them play an active part in all fermentations under the name of microzymas. He supposes that in urine there are abnormal microzymas, which transform urea into carbonate of ammonia. Verneuil thinks that leucocytes may modify urea like the Torulacea of Pasteur and Van Tieghem. M. Bouley ascribes the change possibly to pus, blood, or mucus, while Poggiale hesitates to attribute this part of hydration exclusively to the Torulacea. As regards the origin of the vibriones, there are two conflicting schools—the heterogenists (Dr. Bastian, Onimus, etc.), who believe in the creation of the little beings in the midst of the urine by the concourse of physico-chemical forces; and the physiological school, of which Pasteur is the most eminent representative, and which ascribes the birth of vibriones to vibriones, the air being a means of transport of these animalcules and their germs. The authors have experimented on the subject—not in glass vessels, like M. Pasteur—but in the bladders of living animals, or, as they rather curiously express it, *in anima vili!* The urine of dogs was rendered alkaline, either by the administration of bicarbonate of soda, acetate of potassa, etc., or by certain nervous lesions, but when withdrawn from the bladder by means of an operation it was invariably found free from ammoniacal fermentation, and contained neither torulaceæ nor vibriones. If, however, air was admitted into the bladder by a slit, ammoniacal fermentation speedily set in, and vibriones made their appearance.

NEW METHOD OF DETERMINING CASEIN AND FATS IN MILK.

By JULIUS LEHMANN.

THE author, after pointing out the impossibility of deciding on the quality of milk otherwise than by a quantitative analysis, and after pronouncing all known methods too tedious and circumstantial, speaks of his experiments on the behavior of milk upon baked plates of porous clay. From these experiments it appears that if milk is poured slowly upon such plates by means of a pipette or small glass syringe in a continuous stratum of about 2 m.m. in thickness, there remains, after the lapse of one or two hours, a consistent coating with a sharply-defined outline, of a pale yellowish color and a fatty lustre, which can be readily removed from the plate by means of a sharp horn spatula in the form of fine translucent laminæ. After exposure for some time to moderately dry air, or especially if dried over sulphuric acid, they become so brittle that they can be broken between the fingers. At a temperature of about 30° fat exudes out of the laminæ and covers their entire surface. After extraction with ether there remains a white, translucent, easily friable mass. This, when thoroughly freed from fat, consists of casein, containing ash, and very small proportions of albumen and milk-sugar. Hence the two latter substances are capable of being separated from the serum by means of clay plates. It further appears that in this manner casein may be separated with the same properties as if it had been precipitated by rennet. If rubbed up with water it swells to a white flocculent matter, which remains behind on filtering the mixture through blotting-paper. On treatment with lime-water it returns to the state in which it originally existed in the milk. It then passes through filter-paper along with water, and can be precipitated with acetic acid. If the casein still retains the proportion of fat which was left with it upon the plates of clay, it forms, when rubbed up with lime water, a liquid quite similar to milk. In this casein, and in that precipitated with rennet, the proportion of ash is, on an average, 8·5 per cent., while that precipitated with acetic acid contains only 1·8 per cent., the chief constituent of which in the latter case, is di-hydro-calcium phosphate, while in the two former it is neutral tri-calcium phosphate. The above observations confirm the view of Hoppe-Seyler, of Soxhlet, and Hammarsten, that casein exists in milk not in solution, but merely in a strongly swollen state. If dissolved it would be absorbed by the clay plates like the albumen. The same observations prove that the fat-globules in milk are not enveloped in capsules of solid matter, since the fat exudes at a gentle heat, and can be readily washed away with ether. The application of these observations to the quantitative determination of casein and milk-sugar depends, in the first place, on the existence of earthenware plates with pores so fine as not to absorb the milk-globules as such. The author has been able to procure such plates from one firm only. The method of performing the analysis is as follows: Suitable plates, after having been heated for some time to about 100° and cooled again, are held in a sloping position, quickly drenched with a thin stream of water upon their smooth surface, and placed on a glass vessel of suitable width, the bottom of which is covered with a thin layer of concentrated sulphuric acid. The milk in question, previously diluted with an equal weight of distilled water, is cautiously run upon the middle part of the plate in a connected layer by means of a small glass syringe, and covered with a smooth-edged glass capsule to prevent evaporation. To ascertain the weight of the portion taken for analysis the syringe is weighed both before and after pouring the milk upon the plate. From 9 to 10 grms. of diluted milk are sufficient. After the lapse of one or two hours the serum will be found to have been absorbed to such an extent that the cake can be removed by means of a sharp horn spatula

specially designed by the author for this purpose, and placed in a balanced watch-glass. This residue is then dried in the air-bath at 105°, which can be completed in two hours, and weighed. In this manner the joint weight of casein and fat is obtained. The dry matter, without being previously pulverized, is placed upon a tared filter, dried at 105°, by means of forceps, and washed in the first place with a small quantity of ether. It is then thrown into a small smooth glass mortar provided with a spout, and most finely pulverized with the addition of a few drops of absolute alcohol; ether is added, so as to wash the whole into the filter, where it is further washed till completely free from fat. After the evaporation of the filtrate of alcohol and ether the fat remains in the small flask, which must be previously tared, and which is weighed again when the evaporation is completed. In order to determine the casein, it is merely needful to dry the filter with the residue as long as any loss of weight takes place, and then to weigh. As the casein contains a considerable proportion of ash, this must be separately determined and deducted. The casein thus obtained, on being submitted to ultimate analysis by the soda-lime process, was found to contain 15·57 per cent. of nitrogen as calculated for the pure substance free from ash. On comparing the results with those obtained by Hoppe-Seyler's process, the amount of casein appears greater according to the former, especially as in the latter method a part of the precipitate obtained with acetic acid is re-dissolved on washing. The 1·8 per cent. of ash contained in the casein obtained on Hoppe-Seyler's method has hitherto been left entirely unnoticed. The author announces that as soon as a stock of suitable clay plates have been prepared he will give the address of the firm from whom both these and all other articles required for the execution of the process may be obtained.—*Annalen der Chemie.*

INCOMBUSTIBLE SILICATE BOARD.

THE process for manufacturing silicated paper board, principally designed for roofing, simply consists in impregnating sheets of the paper board alternately in a solution of silicate of soda or of potash, and in another of chloride of barium or of another salt. The chloride of barium can be replaced by other soluble salts which are cheaper, provided that they give insoluble silicates, such as the salts of lime, aluminium, magnesia, iron, lead, zinc, etc. The entire mass of the board is thus impregnated with a silicate of baryta or other equally insoluble substance, and, at the same time, with a certain quality of silica. These substances not only enter, but form, in the very substance of the sheet, an insoluble varnish which protects it against the weather, increases its resisting power, and renders it incombustible. Instead of making use of prepared board, the matters can be incorporated in the pulp. This proceeding is equally applicable to paper, wood, stuffs, etc. It will take various colors, and is extremely light and economic.—*Bulletin du Musée de l'Industrie de Belgique.*

HEAT, SULPHURIC ACID AND WATER.

According to E. Maumené, sulphuric acid recently heated does not liberate the same amount of acid with water as an identical acid which has been preserved for some months. This phenomenon seems to him to introduce into thermochemical researches a source of error of which no account has been taken.—*E. Maumené.*

PHYLLIC ACID.

BOUGAREL has succeeded in isolating from the leaves of the cherry-laurel, a new acid to which he gives the name phyllic acid. The leaves are extracted with boiling alcohol; the extract left on distilling off the alcohol, is treated with ether; the solution is clarified with animal charcoal, the ether distilled off, and the amorphous grains dissolved in dilute potash solution and several times crystallized. On re-dissolving and adding an acid, phyllic acid is precipitated as a resinous mass. It is soluble in alcohol, ether, chloroform, CS_2, essential oils and fats, but insoluble in water. Several times precipitated from ether, it forms a fine powder without odor or taste, having a density of 1·014, rotating in alcoholic solution, $aj = +28$, melting at 170°, and decomposing at 200°. Analysis of the potassium salt fixed the molecular weight at 624; and ultimate analysis, consequently, the formula $C_{19}H_{24}O_{12}$, which the author regards as provisional only. The sodium and ammonium salts are well crystallized. The acid has also been obtained from the leaves of the quince, apple, peach, almond, sycamore, lilac and 'aborandi.—*Bull. Soc.*

SOLUBILITY OF SUGAR IN WATER.

By M. H. COURTONNE.

100 grms. of water at 12·5° dissolve 198·647 grms. of sugar, and at 45°, 245 grms. In other words, a solution of sugar saturated at 12·5° contains 66·5 per cent., and a solution saturated at 45° contains 71 per cent.

IODOUS ACID.

By M. J. OGIER.

WE may operate, either by causing ozonized oxygen to act upon the vapor of iodine, or by submitting a mixture of oxygen and iodine to the electric effluve. In each case the products are the same: the ultimate stage of an oxidation sufficiently prolonged is always a white or yellowish matter, unalterable in the air, soluble in water without apparent decomposition, and in which the oxygen and iodine were found united in the proportions suitable for iodic acid. In certain cases the author obtained a product sparingly soluble in water, the properties of which agreed with Millon's hypoiodic acid. The following arrangement was adopted for the formation of iodous acid: A rapid current of ozone was led by a tube to the bottom of a flask containing iodine kept at 44° to 50°. The ozone being immediately destroyed on contact with the vapor of iodine, the solid particles formed were carried with the excess of oxygen along a lateral tube. A series of narrow glass tubes containing platinum spirals serves to break the gaseous current, and to arrest these particles whose tenuity is extreme. The product is a pale yellow powder, exceedingly light. If treated with water iodine is precipitated. If exposed to moist air it seems to disappear in a few seconds.

TO TEST SOAPS, dissolve twenty parts in water, and mix with five parts of diluted sulphuric acid. The fat rises to the top, and the mineral impurities fall to the bottom. In this manner, says a scientific contemporary, the most flagrant adulterations can be detected.

SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department, may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

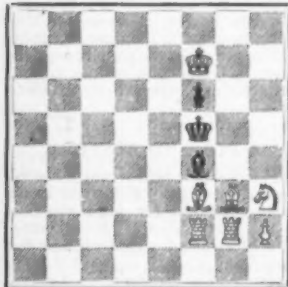### PROBLEM No. 48. BY JAMES MASON.

Black.
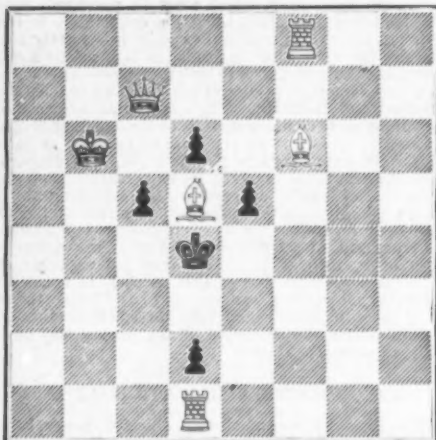
White.

White to play and mate in three moves.

JAMES MASON AND THE CENTENNIAL TOURNEY.

White to play and mate in 2 moves.
By JONATHAN HALL, Centennial Problem.

LATE as it may seem, we take this the first opportunity of giving an account of the interesting chess tournament held at Philadelphia during the Centennial Exhibition.

There were eight players entered, each one of whom was to contest two games with every player, draws to count half a game for each player, prizes to be awarded in proportion to the number of games won.

The following score shows the result of the tournament as concluded on the 31st of August, 1876:

Mason, 1st prize, $300, and Gov. Garland's silver cup.
Judd, 2d prize, $200, and a gold medal.
Bird, 3d " $150, " "
Elson, 4th " $100, " "
Davidson, 5th " $ 50, " "
Roberts, 6th " $ 8, " "

Barbour and Martinez not receiving prizes.

It is flattering to our problemists that the six prize-bearers should all belong to the fraternity, Elson having also won prizes in the Centennial Problem Tournament, whereas Judd and others have received prizes in other tournaments.

Mr. Mason is so well known as a player through having carried off the highest honors in the *Clipper* Tournament, New York Chess Club, and many matches, that he is looked upon by many as our strongest player, and will doubtless be our champion if the playing fraternity can be induced to emulate the enthusiasm and liberality that have been inaugurated by the Problematical branch of the association.

If the players do not hold a tournament for this purpose, as has been proposed, the problemists will have to take the matter in hand and select a champion, in which case we are strongly in favor of Mr. Mason, who has developed undoubted talent for problems, and would represent both branches. We give one specimen of his skill which baffled the most of the *Journal* solvers, and also select the decisive game for 1st and 2d prizes between Mason and Judd.

We give this week our Centennial two-mover that created so much discussion across the water, and extract from the *Amateur World* (which was the first to publish Herr Mares' "impertinent" *improvement*) the following letter from Mr. Collins, the well known problemist and Vice-President of one of the London clubs.

TO MR. J. T. PALMER, Hull:

DEAR SIR: I should like to state that I consider Mr. Loyd's two move prize problem a most clever and beautiful one in every respect, and well worthy of the honors it obtained, and I cannot imagine anything finer or better worked out than in the two-mover over which there has been so much said, as well as bad and envious feeling displayed by fault-finders. I shall thank you to make my opinion known in the *Amateur World*.   Respectfully Yours,
F. C. COLLINS,
London.

A correspondent of the *Town and Country Journal* closes a long criticism upon this problem in the following flattering terms:

I am not prepared to assert that our American and Continental friends possess any perfected standard of excellence, whereby the true value of a composition may be infallibly calculated—indeed, I do not suppose they have—but I am prepared to say, from my examinations of the works of some of the masters of the art in both places, that they are pretty well determined on one very important point. Beyond all else would appear the necessity to have and preserve ingenuity and beauty of stratagem. To this end such matters of mere detail as neatness of position, difficulty of solution, and even duals are secondary considerations, and must ever be held subordinate; indeed they would seem, if the problems under notice be any criterion of the prevailing taste, to be matters entirely without the pale of either the composer's or arbiter's calculation or care. This, then, is the grand principle to which I would direct the attention of our solvers. Nothing must be allowed to interfere with the author in his strategic designs. This is the principle taught by Bayer, Berger, and other eminent German and French composers. It is the principle taught by the judges in the greatest tournament of our or of any time, and it is the principle in problem construction, which I hope to find recognized among our own critics as the groundwork of a problem code whereby the worth or worthlessness of the compositions placed before them weekly for judgment may in the future be estimated.

That Loyd's problem bears me out must be admitted by any who will but examine the position. At the risk of indicating the key move and leaving a multitude of duals, he has succeeded in retaining a stratagem which, for boldness of design and beauty of execution, has not, at least in my experience, its fellow. I would rather be the composer of one such problem than the author of ten of the "stale, flat and unprofitable," though, withal, correct things, wherein every defence of black's is already provided for, with the one exception of the outlet, which the key move is specially intended to meet.

JAMES MASON.

### PHILADELPHIA CENTENNIAL TOURNEY.

MAX JUDD.	JAMES MASON.
WHITE.	BLACK.
1. P to K 4	1. P to K 3
2. Kt to K B 3	2. P to Q 4
3. P x P	3. P x P
4. P to Q 4	4. Kt to K B 3
5. B to Q 3	5. B to Q 3
6. Castles.	6. Castles.
7. P to K R 3	7. B to K 3
8. Q Kt to B 3	8. P to B 3
9. B to K 3	9. Q to B 2
10. Kt to K R 4	10. Q Kt to Q 2
11. P to K B 4	11. Kt to Kt 3
12. P to Q Kt 3	12. Q R to K sq
13. B to Q 2	13. B to B sq
14. Q to B 3	14. Q to K 2
15. Kt to B 5	15. B x Kt
16. B x B	16. Kt to K 5
17. B x Kt	17. P x B
18. Q to Kt 3	18. P to K B 4
19. B to K 3	19. R to B 3
20. Q to B 2	20. R to Kt 3
21. Q R to Q sq	21. B to Kt 5
22. Kt to K 2	22. Kt to Q 4
23. P to Q B 4	23. B x B
24. Q x Kt	24. B to R 4
25. P to Q R 4	25. B to Kt 3
26. R to Q 2	26. B to R 4
27. R to B 2	27. R to Q sq
28. R to Q sq	28. K R to Q 3
29. K to R sq	29. K R to Q 2
30. R to B sq	30. R to B 2
31. P x Kt	31. R to R 4
32. K to Kt 2	32. Q to B 3
33. P to K R 4	33. B to Kt 5
34. R to Q Kt 4	34. B to B 4
35. P to Q Kt 4	35. B x P
36. Kt x B	36. R x Kt
37. R x R	37. Q x R
38. Q x Q	38. R x Q
39. R to Q B sq	39. K to B 2
40. K to B 2	40. R to Q 6
41. R to B 2	41. K to Kt 3
42. K to K 2	42. K to R 4
43. K to R 3	43. P to K R 3
44. P to B 5	44. R to R 3
45. R to Q 2	45. R to Q 6
46. R to Q Kt 2	46. P to K Kt 4
47. B P x P	47. P x P
48. R to K B 2	48. P to B 5 and wins.

PROBLEM No. 49. PRIZE FOR BEST TWO MOVER.

CENTENNIAL SET THEMES. BY S. LOYD.

Black.
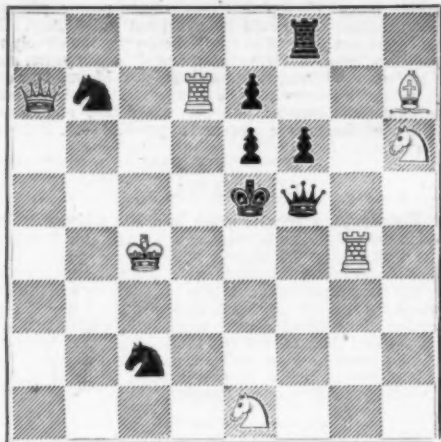
White.

White to play and mate in two moves.

SOLUTIONS TO PROBLEMS.

No. 42.—BY L. W. MUDGE.

WHITE.	BLACK.
1. B to Q 4	1. K moves
2. B to Kt 4	2. "
3. Kt to K 2	3. "
4. Mates.	

No. 48.—BY L. W. MUDGE.

WHITE.	BLACK.
1. B to Q 6	1. Any move
2. Mates.	

LETTER "J."—BY L. W. MUDGE.

WHITE.	BLACK.
1. R to B 8	1. R to K sq
2. R x R ch	2. K moves
3. Q mates.	
1.	1. P to Q 3
2. Q to K R 3 ch	2. Moves
3. Q mates.	
1.	1. P to Q 4
2. Q to Q Kt 6 ch	2. K to Q 2
3. Q to B 6 mate.	

If black play P to B 3 or 4, Q checks at Kt 3 or R 6, etc.

ENIGMA No. 6. BY L. W. MUDGE.

1. B to K R 4, K to K 7, 2. Q to R 5, etc.

ENIGMA No. 7.—BY F. W. MARTINDALE.

1. Q to K B 8, and mate follows.

ENIGMA No. 8.—BY F. W. MARTINDALE.

1. K R to Q sq, P x R. 2. R to K 4 ch, and mate follows.

ENIGMA No. 9.—BY R. H. SEYMOUR.

1. Kt x P, K x Kt. 2. R to Q 3 ch, and mate follows.

ENIGMA No. 10.—BY X. HAWKINS.

1. B to K 3, and mate follows.

ENIGMA No. 11.—BY X. HAWKINS.

1. Q to Kt 8, and mate follows.

ENIGMA No. 12.—BY S. LOYD. SET "IDEAS."

First Prize Set of Centennial Problem Tourney.

White.—K on K R 6, Rs Q 8 and Q R sq, B K Kt 8, Kts Q R 5 and Q B 4, Ps Q B 2, Q 2, K 6, K B 3 and 4.
Black.—K on Q B 4, B Q Kt sq, Kt Q B 2, P Q R 2 and 3 and K 2.
White to play and mate in four moves.

ENIGMA No. 13.—BY S LOYD. SET "IDEAS."

White.—K on Q B 2, Q K R 8, B Q Kt 3, Kt K Kt sq, Ps Q Kt 2, Q 5, K 6 and K B 2.
Black.—K on K Kt 5, R Q Kt 5, Ps Q B 6, K B 4 and 6, K Kt 3 and 4.
White mates in four moves.

ENIGMA No. 14.—BY S. LOYD. SET "THEMES."

Second Prize Set, Centennial Problem Tourney.

White.—K Q Kt 6, Rs K R sq and Q 5, Bs K B sq and Q R 3, Kt K sq, Ps K R 2, Q B 4 and 5.
Black.—K on Q 8, Ps Q B 3, Q 6 and K 7.
White mates in four moves.

ENIGMA No. 15.—BY JACOB ELSON.

Third Prize Set, Centennial Problem Tourney.

White.—K on Q R 7, R Q B 8, B K R 2, Kts K 8 and K Kt 4, Ps K B 5, Q 3, Q B 2 and Q R 3.
Black.—K on Q 5, R Q Kt 8, B Q R 8, Kts Q R 7 and K Kt 2, Ps on K B 3, Q 4, Q B 6 and Q Kt 4.
White to play and mate in two moves.